ABSTRACTS

08463 **Abegglen, Donn E.; Wallace, Alfred T.; Williams, Roy E.** The effects of drain wells on the ground-water quality of the Snake River plain: Idaho Bur. Mines and Geology Pamph. 148, 51 p., illus., tables, 1970.

The eastern Snake River plain aquifer of southern Idaho comprises a series of basalt flows with interflow pyroclastic and sedimentary materials. The aquifer is the highest yielding water-bearing sequence of rocks in Idaho and the principal domestic water source for the area. Drain wells on this plain extend into fractured basalt aquifers of southern Idaho and are being used for disposal of sewage, street drainage, irrigation excess water, and industrial wastes. Some 5000 such wells are in use, of which about 3000 are in Lincoln, Jerome, and Gooding Counties. A bacterial pollution problem exists on a local scale and corrective measures should be instituted immediately to protect public health. Drain wells can be eliminated if municipal sewerage, above-ground and subsurface soil absorption systems, and sedimentation-recirculation systems are implemented. — VSN

01054 **Acker, Frank E.** Calculation of the signal voltage induced in a toroidal proton-precession magnetometer sensor: IEEE Trans. Geosci. Electronics, v. GE-9, no. 2, p. 98-103, illus., 1971.

The signal EMF induced as a function of time in a proton-precession magnetometer sensor of toroidal shape with an elliptical cross-sectional area is calculated in terms of the magnetic properties of the sensor fluid, polarizing current, orientation of the sensor. It is assumed that the sensor is in a uniform ambient magnetic field; the polarizing current is reduced to zero in a time that is short compared to the period of the fluid; the nuclear magnetic moments do not interact; and no significant current flows in the sensor winding during the relaxation process in which the EMF is measured. In the specific case that the sensor winding fills the toroid window and that the polarizing supply is a constant voltage source, the calculations permit a simple comparison of variously proportioned sensors in terms of the signal EMF amplitude. — Author's abstract

08595 **Adams, William M.; Mathur, Surendra P.; Huber, Richie D.** Aeromagnetic, gravity, and electrical resistivity exploration between Pahala and Punaluu, Hawaii: Hawaii Univ. Water Resources Research Center Tech. Rept. 28, 60 p., illus., tables, 1970.

Data from aeromagnetic, electrical resistivity, and gravity surveys conducted between Pahala and Punaluu, Hawaii, to delineate barriers to ground-water movement are interpreted and compared to determine sectors of relatively low gradient ground water between barriers. In the Pahala area two barriers are defined: the Kolea barrier, which trends roughly east to west, and the Pahala dump barrier, associated with a "crack" used as a dump, which appears to terminate at the Kolea barrier. In the Punaluu area, electrical sounding and profiling observations agree with conclusions of an earlier infrared study that a large fresh-water outflow, associated with a relatively high head of the water table, occurs. Magnetic and gravity observations agree on the presence of a skewed prismatic body whose top is near the ground surface. Two test holes drilled in the area verify the geophysical predictions. — *from* Authors' abstract

01616 **Agterberg, F. P.** Autocorrelation functions in geology, *in* Geostatistics — A colloquium (D. F. Merriam, editor), Lawrence, Kan., 1970, Proc.: New York, Plenum Press, p. 113-141, illus., tables, 1970.

By using a method originally developed by P. Whittle, it is shown that a continuous random variable in three-dimensional space has an exponential autocorrelation function if it is subject to a property analogous to the Markov property in time-series analysis. The problem of estimating autocorrelation functions from irregularly distributed map data is discussed. Approximate autocorrelation functions are shown for a set of 200 subsurface elevations on top of the Arbuckle Group (Cambrian-Ordovician) in Kansas. Trend-surface analysis, a method of kriging and a combination of the two procedures also are applied to the data. Areal interpolation can be done by a method that consists of three steps: (1) fitting a low-order polynomial trend surface; (2) estimation of the autocorrelation function for the residuals; and (3) application of kriging to the residuals. — Author's abstract

01132 **Ahrens, Thomas J.; Takahashi, Taro.** Static and dynamic compression of earth materials, *in* Tectonophysics, U.S. National Report, 1967-1971, Fifteenth General Assembly, IUGG: EOS, v. 52, no. 5, p. IUGG 147-153, 1971.

Highlights of progress during 1967-1970 on compression of earth materials included hydrostatic compression measurements on Apollo 11 samples, static compression measurements on the spinel phase of Mg-Fe silicate solid solutions which are likely constituents of the transition zone of the Earth's mantle, and Hugionot data for ferromagnesian silicates which may represent the lower mantle constituents. This is a summary and bibliography on static and dynamic compression measurements pertinent to the materials of the Earth's interior. — DBV

01296 **Akers, J. P.; Shorty, J. C.; Stevens, P. R.** Hydrogeology of the Cenozoic igneous rocks, Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah: U.S. Geol. Survey Prof. Paper 521-D, p. D1-D18, illus., tables, 1971.

Volcanic rocks in these reservations occur as flows, dikes, necks, cinder cones, and bedded tuff in fillings of diatremes and beneath some lava flows in volcanic fields and are grouped by composition into the monchiquite province (probably Pliocene) centered in the Hopi Buttes, minette province (older than the monchiquite), and basalt province (Pliocene to late Holocene) in the southwestern part of the reservations. Wells obtain water from tuffaceous material filling diatremes, and most springs discharge from bedded tuff beneath lava flows. Of 14 test wells in diatremes in Hopi Buttes area, eight produced sufficient quantity of potable water for domestic or stock use. The amount and quality of water obtainable from a given diatreme cannot be predicted, and additional development of water from volcanic rocks is limited to diatremes. — VSN

01208 **Akers, W. H.** Estuarir.e foraminiferal associations of the Beaufort area, North Carolina: Tulane Studies Geology and Paleontology, v. 8, no. 3, p. 147-165, illus., table, 1971.

An inventory of foraminifera in the Beaufort area shows that patterns of distribution are similar to those of other estuarine environments. The known geographic ranges of several species reported previously from Trinidad and the northern Gulf of Mexico are extended northward to the Beaufort area. Living foraminifera were found at low tide in an intertidal marsh among the roots of *Spartina alterniflora*, in moist mud of the upper few centimeters down to 35-40 centimeters below the marsh surface. A new species of *Miliammina* (*M. beaufortensis*) is described from the surface of this marsh. — Author's abstract

01248 **Allen, Donald G.** The origin of sheet fractures in the Galore Creek copper deposits, British Columbia: Canadian Jour. Earth Sci., v. 8, no. 6, p. 704-711, illus., 1971.

A surface feature characteristic of the Galore Creek copper deposits is a set of well-developed closely-spaced fractures, termed sheet fractures. Formation is attributed to the widespread presence of anhydrite, a hydrothermal alteration mineral associated with copper. The fractures apparently developed as a consequence of the volume increase due to hydration of anhydrite to gypsum by meteoric water. The deposits have many characteristics of porphyry copper in many of which anhydrite or gypsum has been reported. Anhydrite may be responsible for development of sheet fractures elsewhere. — *from* Author's abstract

01385 **Allen, John Eliot.** One man's bout with TV, *in* Teaching introductory college geology by television — Council on Education in the Geol. Sci. Pub. 6: Washington, D.C., Amer. Geol. Inst., p. 35-36, 1971.

A beginning geology course given by the author on closed-circuit television at Portland State University, Portland, Oregon, from 1964-68, was discontinued. The television course had no effect on student grade curves. Both the students and the professor missed the personal contact of standard courses. The author concludes that good teachers do not necessarily project on television and that instinctive television charisma in a teacher is rare. — EH

Allman, R. L. *See* Igarashi, Y. 08623

Ambrose, J. W. *See* Nidd, Eric. 01249

08496 **Amos, Dewey H.; Desborough, George A.** Mafic intrusive rocks of Precambrian age in southeast Missouri (Contribution to Precambrian geology No. 3): Missouri Geol. Survey and Water Resources Rept. Inv., no. 47, 22 p., illus., tables, geol. map, 1970.

The location and extent of thick sills and dike-like intrusions of mafic rock in the Precambrian of southeastern Missouri are shown on a geologic map of parts of Ironton and Fredericktown quadrangles. Later associated basic pegmatite, acid to intermediate granophyre, and albitite dikes are common. Rhythmic layering and igneous lamination are recognized in larger bodies. Thin section and polished surface studies, X-ray diffractometry of plagioclase and olivine, and X-ray fluorescence analysis of total iron content show enrichment of iron and sodium with decreasing age. High-iron olivine and minor sphalerite characterize undifferentiated rock. Local hydrothermal alteration is evident. Field, structural, and petrologic data indicate limited in situ differentiation and gravitational separation of larger intrusions and a genetic relation to iron mineralization. — *from* Authors' abstract

Anders, Edward. *See* Keays, Reid R. 01069

01100 **Anderson, C. A.; Blacet, P. M.; Silver, L. T.; Stern, T. W.** Revision of Precambrian stratigraphy in the Prescott-Jerome area, Yavapai County, Arizona: U.S. Geol. Survey Bull. 1324-C, p. C1-C16, illus., geol. map, 1971.

Metamorphosed volcanic, volcaniclastic, and sedimentary rocks that predate the oldest plutonic rocks (1,770 ± 10 m.y.) in the Prescott-Jerome area are placed in the Yavapai Series, a provincial time-stratigraphic term defined as the interval from 1,770 ± 10 to 1,820 + m.y. Two rock-stratigraphic groups are recognized; the Ash Creek Group is separated from the Big Bug Group by a major fault and a large pluton of quartz diorite. Isotopic dating now indicates that Ash Creek Group is older. The name Big Bug Group replaces the term Alder Group. Within Big Bug Group the Indian Hills Volcanics and Green Gulch Volcanics are the same formation; the latter term is retained. The term Chaparral Volcanics is abandoned, and Texas Gulch Formation is removed from the Yavapai Series. — *from* Authors' abstract

01136 **Anderson, Don L.** Structure and composition of the mantle, *in* Seismology, U.S. National Report, 1967-1971, Fifteenth General Assembly, IUGG: EOS, v. 52, no. 5, p. IUGG 174-175, 1971.

The last four years have been a period of increased emphasis on the problems of discontinuities, lateral variations, and shear velocities in the mantle. Sharp discontinuities near 400 and 600 km have been verified, and other discontinuities or sharp gradients have been found. Relatively few large radial stretches of the mantle are truly homogeneous. Ultrasonic and shock wave measurements in the laboratory have contributed to progress in the composition of the mantle. — DBV

08547 **Anderson, Franz E.** The periodic cycle of particulate matter in a shallow, temperate estuary: Jour. Sed. Petrology, v. 40, no. 4, p. 1128-1135, illus., 1970.

The concentration of particulate matter in the Bellamy River estuary, New Hampshire, has been determined to be strongly periodic over tidal cycles in the

spring and early summer months and weakly periodic or aperiodic during the rest of the year. The variation in periodicity appears to be a function of changing estuarine circulation patterns with river discharge, and the protection of the tidal flat by ice and slush during the winter months. — Author's abstract

08599 **Antoine, J. W.; Pyle, T. E.** Crustal studies in the Gulf of Mexico, *in* The structure of the crust and mantle beneath inland and marginal seas — Internat. Upper Mantle Comm. Upper Mantle Project, Sci. Rept. No. 29: Tectonophysics, v. 10, no. 5-6, p. 477-494, illus., 1970.

Eastern margins of this Gulf are carbonate platform buildups with bordering buried reefs that controlled Mesozoic and Cenozoic sedimentary history. They are best known off Florida, but their existence near Yucatan suggests that a Lower Cretaceous reef complex may have nearly encircled the Gulf in a system including the Golden Lane (Faja de Oro) of Mexico, oil-producing trends in Texas and Louisiana, and perhaps northern Cuba; seismic reflection data suggest its separation into platforms by erosion and faulting. Western margins of the Gulf are thick terrigenous clastics with linear folds complicated by buried Mesozoic salt; possible post-Paleozoic development of diapirism is outlined. The central basin is quasi-oceanic; great thickness of sediments and a northern extent of oceanic-type crust, indicated by seismic and gravity studies, suggest a long history of fill and increased depth to the M-discontinuity. — GDC

01176 **Arem, Joel E.** Stereoscopic representation of four-component chemical systems: Contr. Mineralogy and Petrology, v. 30, no. 2, p. 95-102, illus., tables, 1971.

A method has been derived for computer plotting of four-component chemical systems (tetrahedra), using the program ORTEP (Johnson, 1965). Stereo pairs can be produced and the tetrahedron viewed from any desired position. The only input information needed is phase composition and tie-line arrangement within the tetrahedron. — Author's abstract

01279 **Arkley, R. J.** Factor analysis and numerical taxonomy of soils: Soil Sci. Soc. America Proc., v. 35, no. 2, p. 312-315, illus., table, 1971.

A large computer and multivariate statistics were used to select a minimal number of soil properties with the greatest prediction value for use in soil classification. Key communality cluster analysis and principal axis factor analysis with Varimax rotation were applied to six sets of data containing from 21 to 66 profile characteristics. Composite factor scores computed for each soil were also used for Numerical Taxonomy. Groupings formed were sufficiently similar to those of the new classification system of the USDA to suggest that these methods may be very useful in soil classification. Development of coordinate system of soil classification by these methods is discussed. — *from* Author's abstract

Armstrong, Augustus K. *See* Greenwood, Eugene. 08649

08657 **Armstrong, Augustus K.** Mississippian stratigraphy and geology of the northwestern part of the Klondike Hills, southwestern New Mexico, *in* Guidebook of the Tyrone-Big Hatchet Mountains-Florida Mountains region — New Mexico Geol. Soc. Field Conf., 21st, 1970: Socorro, N. Mex., New Mexico Bur. Mines and Mineral Resources, p. 59-63, illus., 1970.

This preliminary report represents an initial phase of a restudy of the outcrop area of Mississippian carbonates, with focus on petrology, facies, and biostratigraphy. The Klondike Hills trend northwest-southeast and rise 300 feet above the surrounding pediment of upper Paleozoic limestones thinly veneered by gravel and soil. The Paleozoic sequence is badly broken by two sets of steep Tertiary faults, one set trending N. 50°-60° W., and the other N. 50°-60° E. Map units, briefly described, are Devonian Percha Shale, Mississippian Keating, Hachita, and Paradise Formations, and Pennsylvanian Horquilla Limestone. In the Klondike Hills, subunits of the Keating do not correspond with members A and B as defined in the type section at Blue Mountain, Arizona, owing to facies changes, and the basal brown sandstone of the Horquilla can be mapped separately from the limestone. — GDC

Armstrong, D. E. *See* Shukla, S. S. 01276

Armstrong, D. E. *See* Williams, J. D. H. 01277

08427 **Arnow, Ted.; Feth, J. H.; Mower, R. W.** Ground water in deltas of the Bonneville Basin, the Great Basin, U.S.A. [with French abs.], *in* Symposium on the Hydrology of Deltas, V. 2: Internat. Assoc. Sci. Hydrology-Unesco Pub. 91, p. 396-407, illus., table, discussion, 1970.

Deltaic deposits that formed in the Bonneville Basin in the Great Basin during Pleistocene, and possibly late Tertiary, time now are important ground-water reservoirs. Among the largest deltas are those of the Weber and Sevier Rivers [Utah]. Each contains two principal artesian aquifers, recharged by seepage from streams and other sources. The Weber Delta in places contains fresh water to a depth of 1,300 feet. This water is of three chemical types; two probably original. The Sevier Delta in places contains fresh water to a depth of about 1,200 feet. Recharge that has occurred since irrigation began upstream has resulted in introduction of slightly saline water that is slowly moving downdip in the aquifers. — *from* Authors' abstract

01035 **Aumento, F.** Uranium content of mid-oceanic basalts: Earth and Planetary Sci. Letters, v. 11, no. 2, p. 90-94, illus., table, 1971.

Tholeiitic basalts from the Mid-Atlantic Ridge at 45° N. may have extruded with an original total uranium content between 0.19 and 0.30 ppm U. Deep-sea weathering increased the uranium concentration of most basalts at the rate of at least 1 ppm per 10 m.y., equivalent to 1 ppm for every 2 percent sea water absorbed. — Author's abstract

01247 **Aumento, F.; Loubat, H.** The Mid-Atlantic Ridge near 45° N. — [Pt.] 16, Serpentinized ultramafic intrusions: Canadian Jour. Earth Sci., v. 8, no. 6, p. 631-663, illus., tables, 1971.

The mineralogy, petrography, geochemistry, and physical properties of serpentinized ultramafic rocks dredged from the Mid-Atlantic Ridge at 45° N. support events which affected these rocks after their original crystallization. Crystallization took place in lopoliths emplaced at the crust/upper mantle interface beneath the axis of the ridge under conditions quiet enough to permit gravity crystal differentiation and layering. Rocks were then fractured without hydration under high hydrostatic pressure, possibly under conditions favoring solid-state recrystallization of interstitial minerals. Hydration (amphibolization) began during last phases of mechanical deformation and commencement of rodingitic metasomatism. Further hydration resulted in multiple overlapping periods of serpentinization. Hydrating fluids may have been derived from juvenile or sea water. — *from* Authors' abstract

08537 **Avent, Jon C.** Correlation of the Steens-Columbia River Basalts — Some tectonic and petrogenetic implications, *in* Columbia River Basalt Symposium, 2nd, Cheney, Wash., 1969, Proc.: Cheney, Eastern Washington State College Press, p. 135-156, illus., tables, 1970.

Regional stratigraphic patterns demand correlation of the Steens Basalt with the Columbia River Basalt (Picture Gorge and Yakima), a correlation supported by K-Ar dates. The Steens Basalt may have been derived from the same tholeiitic parent magma as the Columbia River lavas, but it is more likely an alkali olivine basalt representing simultaneous generation at greater depth. The Steens Basalt may have preceded the Basin and Range tectonism responsible for the present Steens-Pueblo Mountains. — DBV

Ayres, George. *See* Tolbert, Al. 01262

01111 **Ayres, L. D.; Lumbers, S. B.; Milne, V. G.; Robeson, D. W.** (compilers). Ontario geological map, southern sheet: Ontario Dept. Mines and Northern Affairs Map 2197, scale 1:1,013,760, 1971.

08626 **Baer, A. J.** (editor). Basins and geosynclines of the Canadian Shield — Symposium, Ottawa, 1970, Papers: Canada Geol. Survey Paper 70-40, 265 p., illus., tables, 1970.

This symposium was held in Ottawa on March 17-18, 1970. Eight principal papers dealing with 2 Archean and 6 Proterozoic tectonic units formed the basis of the workshop, and culminated in a summation and appraisal by F. J. Pettijohn. An invited audience of about 100 earth scientists representing Canadian and U.S. governmental organizations and universities provided stimulating comments and discussions of the papers. This volume contains the text of the 8 papers and summation, with discussions (all cited separately). — DBV

Baer, A. J. *See* Money, P. L. 08631

Bagby, Robert W. *See* Broadhead, Thomas Webb. 01225

08466 **Bain, George L.** Geology and ground-water resources of New Hanover County, North Carolina: North Carolina Div. Ground Water, Ground Water Bull., no. 17, 79 p., illus., tables, 1970.

This county occupies a peninsula between the Atlantic Ocean and the Cape Fear and Northeast Cape Fear Rivers, it is a relatively flat and low sandy plain underlain by coastal plain formations dipping gently and thickening in a wedge-like fashion toward the sea. Major aquifers furnishing water to wells include a sandstone bed in the Cretaceous Peedee Formation, the Eocene Castle Hayne Limestone, and shallow surface sands. Some wells in the sandstone and limestone aquifers yield more than 400 gpm. Water quality varies widely in regard to hardness, iron content, and salinity. Aquifers are susceptible to salt-water encroachment because formations underlying the Peedee aquifer contain salty water and because of the bordering Atlantic Ocean and brackish Cape Fear River. — VSN

01389 **Bakun, William H.; Johnson, Lane R.** Short period spectral discriminants for explosions: Royal Astron. Soc. Geophys. Jour., v. 22, no. 2, p. 139-152, illus., table, 1971.

Spectra (0-5 Hz) of the P_g phase at JAS, California ($\Delta = 250$-500 km), for 69 events ($M = 2.8$-4.5) located within 100 km of NTS are used to investigate source differences between the short period spectra of nuclear explosions and "natural" earthquakes. The P_g spectral ratio (0.6-1.25 Hz)/(1.35-2.0 Hz) of ground displacement satisfactorily discriminates NTS explosions from "natural" earthquakes for a threshold magnitude at least as low as $M = 3.2$. The explosion spectra are relatively richer in the high frequency band (1.35-2.0 Hz) than are the natural earthquake spectra. An interesting result suggested by this study is that the short period P-wave spectra of "afterevents" of large NTS explosions resemble the spectra of explosions rather than that of "natural" earthquakes. — Authors' summary

Balsley, James R. *See* Leopold, Luna B. 01372

01144 **Banerjee, Subir; Cox, Allan.** Rock magnetism, *in* Geomagnetism and paleomagnetism, U.S. National Report, 1967-1971, Fifteenth General Assembly, IUGG: EOS, v. 52, no. 5, p. IUGG 216-220, 1971.

Work on rock magnetism in the United States in 1967-71 has been concentrated on several important intrinsic problems: whether it is feasible to measure variations in geomagnetic field intensity in rocks as old as Precambrian; what is the exact frequency of geomagnetic reversals throughout earth history; is natural remanence thermal or chemical in origin, and if the latter, when was it acquired. This report is a summary of works on these questions; the bibliography also gives references on other significant research in rock magnetism and related instrumentation. — DBV

08598 **Bank, H.** Durchsichtiger blassgelblicher Plagioklase aus den U.S.A. [A transparent pale-yellow plagioclase from the U.S.A.]: Deutsch. Gemmol. Gesell. Zeitschr., v. 19, nos. 3-4, p. 134-136, illus., 1970.

In attempting to identify two pale-yellow, transparent specimens from the United States, the author found that their refractive indexes fell between those of labradorite and bytownite, and that their specific gravity values in the gemological table were close to labradorite, but in the mineralogical table were closer to bytownite. X-ray analysis proved their identity as plagioclase. Results of X-ray fluorescence and electron probe tests will be given in a later issue of this periodical. — EH

08675 **Banks, Harlan P.** Evolution and plants of the past: Belmont, Calif., Wadsworth Publishing Co., 170 p., illus., tables, 1970.

This textbook is one of the eight comprising the "Fundamentals of botany series"; the other books of the series treat living plants in their various aspects. The present volume is set in a framework of historical geology. Evolution of plants is traced from the first evidence of organic matter in early Precambrian rocks through the Cretaceous origin and Cenozoic evolution of angiosperms; Devonian land plants, the first undisputed vascular plants, receive especially full treatment. Most of the examples are from North America. — VMJ

Baragar, W. R. A. *See* Irvine, T. N. 01258

Baragar, W. R. A. *See* Dimroth, E. 08629

01343 **Barbat, W. F.** Megatectonics of the Coast Ranges, California: Geol. Soc. America Bull., v. 82, no. 6, p. 1541-1561, illus., 1971.

The Coast Ranges are considered in the light of the "new global tectonics." It is proposed that at the end of the Navadan orogeny, a large prism of sediments, ranging in age from Late Jurassic to Late Cretaceous, was deposited across the boundary of the oceanic and the steep-sided sialic crusts. Westward movement of North America, away from the mid-Atlantic rise, caused the oceanic block to underthrust the continental block, in the Coast Range orogeny. The thrust fault, here named the Coast Ranges thrust, passed through the post-Nevadan sediment prism at a gentle angle and separated it into two blocks. The hanging-wall block is relatively undisturbed, and its sediments are identified as the Great Valley sequence. The footwall block is greatly disturbed into a tectonic jumble of sediment and ocean crustal igneous rocks, collectively identified as the Franciscan. — *from* Authors' abstract

00994 **Barbee, James H.** The prediction of Old Faithful's next eruption: Earth Sci. Bull., v. 4, no. 1, p. 37-41, illus., table, 1971.

A mathematical model of an eruption cycle for Old Faithful geyser is developed. The model is based on the assumption that the flow rate of water into Old Faithful's reservoir is constant. The measurement of the eruption height as a function of time allows the volumetric flow rate of water discharged during an eruption to be calculated. This data can be used in the derived model to predict the quiet interval between eruptions with greater accuracy than by the method now used by the Rangers at Yellowstone National Park. — Author's abstract

08635 **Bardack, David.** A new teleost from the Oldman Formation (Cretaceous) of Alberta [with French abs.]: Canada Natl. Mus. Nat. Sci. Pubs. Palaeontology, no. 3, 8 p., illus., 1970.

Paratarpon apogerontus, n.gen., n.sp., is described from the Late Cretaceous Oldman Formation in southeastern Alberta; it is one of the only two fairly complete fishes found during 75 years of collecting from this formation, which is noted for its diverse assemblage of reptiles (the other is a batoid elasmobranch, described by Langston, ibid., no. 6, 1970). The present specimen is a large, deep-bodied elopid, lacking the head but with body and fins preserved intact; it is closely similar to the living elopids *Tarpon* and *Megalops*, particularly the former. The presence of the two fossil fishes, found within 11 miles of each other, indicates that at least one area of the Oldman was subjected to marine incursions. — *from* Author's abstract

Barnes, H. L. *See* Lavery, N. G. 01146

08644 **Basalt Symposium.** Field trip guidebook, [abs.], *in* Columbia River Basalt Symposium, 2nd, Cheney, Wash., 1969, Proc.: Cheney, Eastern Washington State College Press, p. 331-333, 1970.

This is the road log and route map of the field trip conducted on Sunday, March 23, 1969, in connection with the Columbia River Basalt symposium. — DBV

08433 **Bassaget, Jean-Pierre.** Geology of Natashquan area, Duplessis County — Preliminary report [also French edition]: Quebec Dept. Nat. Resources Prelim. Rept. P.R.-582, 13 p., tables, geol. map, 1970.

Except for Pleistocene glacial and delta deposits, all rocks here are Precambrian and include migmatized gneiss and granitic basement cut by pegmatites, and the younger metasedimentary Wakeham Group quartzites, arkose, biotite- and hornblende-paragneisses, and intrusives. Gabbros, parallel to bedding, have become amphibolites; unmetamorphosed pegmatites are structurally related to these and the metasedimentary rocks. Granitization within the Wakeham Group appears near contact with the granitic basement. Wakeham formations are in two complexly folded synclinoria, both cut by a wide band of pegmatite parallel to the synclinal axes; foliation, faults, and joints are in two major trends. White pegmatite and some granitic rocks contain minor magnetite; iron-rich lenses in Pleistocene sands have been explored, but reserves are difficult to estimate. Results of geochemical analyses are given on the geologic map (no. 1712) and tabulated. — GDC

08435 **Bassaget, Jean-Pierre.** Geology of Kégashka area, Duplessis County — Preliminary report [also French edition]: Quebec Dept. Nat. Resources Prelim. Rept. P.R.-597, 18 p., table, geol. map, 1970.

This low, glaciated Precambrian plateau is deeply incised by streams along joints, faults, sinuous gneissosity, or trend of metagabbro dikes. A southwestern swamp-covered sandy terrace is the edge of an old delta of Natashquan River. The predominant granite-granitic gneiss basement complex is intercalated with the metasedimentary Wakeham Group's oldest gray gneisses of various facies. Preserved in large synclinal zones, the overlying assemblage was mainly detrital. Clearly intrusive, porphyritic gneissic granite cuts basement and gray gneiss; metagabbros altered to amphibolite are dikes in basement and sills in the Wakeham Group. Rocks show only local occurrences of chalcopyrite and disseminated magnetite; Pleistocene sands have irregular iron-rich lenses. Geochemical analyses of stream sediments, shown on geologic map (no. 1721) and in a table, have some high values for tin. — GDC

08428 **Bay, Roger R.** Water table relationships on experimental basins containing peat bogs [with French abs.], *in* Symposium on the Results of Research on Representative and Experimental Basins: Internat. Assoc. Sci. Hydrology-Unesco Pub. 96, p. 360-368, illus., 1970.

An experimental basin approach is currently being applied to relatively flat, high-water-table peat-bog catchments in the north-central United States. Precipitation, runoff, and water level data have been collected for 8 years on six forested basins. Shallow water tables in the peat bogs were directly related to runoff and reflected the current hydrologic condition of each bog basin. Instrumentation of the deep ground-water system in each catchment identified some bogs as independent perched basins and one bog as a ground-water discharge area that was influenced by storage changes in the surrounding underground system. The first-year results of a silvicultural treatment applied to one of the experimental basins were analyzed to show that bog basins may be compared by using shallow water table data, provided the basins have similar hydrogeologic conditions. — Author's abstract

01238 **Bayer, Thomas N.; Knell, Kenneth M.** Intriguing pseudofossils: Earth Sci., v. 24, no. 1, p. 19-20, illus., 1971.

A large slab collected from the Reno Member of the Franconia Formation (Upper Cambrian) near Trempeleau, Wis., contained some unusual spindle-shaped structures that were semi-circular in transverse section. It was determined that they must represent casts of linear, tapered openings, restricted to the surface of the bed below, in fact, incomplete mud cracks. This proved that this level, in the midst of a marine sequence, had to have been exposed to the air for a time. — ESL

08459 **Beals, C. S.; Hitchen, A.** On the deposition of sediments in craters [with French abs.]: Dominion Observatory Ottawa Pubs., v. 39, no. 4, p. 105-118, illus., table, 1970.

Scale model experiments in sedimentation have been carried out using a small artificial crater with a depth-to-diameter ratio corresponding to an impact crater a mile in diameter. Experiments were performed under deep water conditions using both mechanical and chemical means of deposition. Results indicate that the crater was obliterated after deposition of a depth of sediments approximately three times the floor-to-rim depth of the crater. Since an impact crater of one mile diameter is about 800 feet deep, the experiments indicate that a crater of this size would be obliterated by sediments of very moderate depth (2400 feet). Profile studies of the model crater made during the process of sedimentary deposition, have revealed interesting analogies with Holleford crater (an ancient meteorite crater filled with Paleozoic sediments) and Mecatina crater, the origin and subsequent history of which are still uncertain. — *from* Authors' abstract

01348 **Beaumont, P.; Oberlander, T. M.** Observations on stream discharge and competence at Mosaic Canyon, Death Valley, California: Geol. Soc. America Bull., v. 82, no. 6, p. 1695-1698, illus., table, 1971.

Rare desert-wash flow was observed in 1970 in Death Valley. At the apex of Mosaic Creek fan, rain of about 0.8 over a steep catchment area of 4.3 sq mi caused discharge in a series of rapidly changing braided channels as much as 10 feet wide. Upstream, flow occurred in only two channels. Discharge in the larger channel was estimated at 26.6 cfs, in the smaller at 4.4 cfs. Average depths were 4 in. and 2.5 in., respectively, and flow was supercritical. Waves as much as 6 in. high (exceeding water depth) were caused by rocks moving downchannel. Largest of the rocks recovered was 5.06 lb; intermediate axis of the largest three stones was greater than maximum depth of water observed. — JHF

08510 **Beck, Charles B.** Problems of generic delimitation in paleobotany, *in* The genus, a basic concept in paleontology — North Am. Paleont. Convention, Chicago, Ill., 1969, Proc., Pt. C: Lawrence, Kans., Allen Press, p. 173-193, illus., 1970.

Using as examples some Upper Devonian progymnosperms, especially the genus *Archaeopteris*, this paper illustrates how the following characteristic features of plant form and development cause problems in generic delimitation in paleobotany: (1) most plant fossils are only small fragments of an originally intact organism of large size, often much branched; (2) some aspects of form and structure may vary at different stages during development and at different locations within a mature individual; and (3) the genetic reaction range in plants allows major morphological changes in response to environment. — DBV

08690 **Beckinsale, Robert D.; Brooks, C. Kent; Rex, David C.** K-Ar ages for the Tertiary of East Greenland: Geol. Soc. Denmark Bull., Dansk Geol. Foren. Medd., English edition, v. 20, pt. 1, p. 27-37, illus., table, 1970.

K-Ar whole-rock ages of extrusive rocks from the Tertiary of East Greenland show variable argon loss, but the oldest ages of 55-60 m.y. are similar to those found for basalt plateaus elsewhere in the North Atlantic Tertiary province. The pattern of ages from samples collected serially in a vertical traverse of a single flow is discussed. Minerals separated from intrusive rocks show the effects of slow cooling and different retentivities for radiogenic Ar-40, with biotites giving generally younger ages than amphiboles. The latter give ages clustering around 50 m.y., which is marginally younger than ages for Tertiary intrusions in the British Isles and West Greenland. The long cooling history recorded in the biotite ages is consistent with evidence for deep burial found in the lowest basalts. — Authors' abstract

08501 **Beerbower, James R.** Graduate paleobiology — The search for futures, *in* Teaching paleontology — North Am. Paleont. Convention, Chicago, Ill., 1969, Proc., Pt. A: Lawrence, Kans., Allen Press, p. 23-27, 1970.

This paper attempts to look at two sets of overlapping futures, the "close-at-hand" into which most graduate students will fit for the next half decade and the "distant" which will be occupied by only a handful until the eighties. The word for the moment is "paleoecology." Traditional systematics and biostratigraphy are on the decline. Most "basic research" in paleobiology as it is now constituted belongs with biology

rather than geology, and much of it is biologically trivial. Professional training must take into account the fact that different criteria for significance exist in basic research, research on theory and method of application, and application itself. Significant changes are necessary at the undergraduate as well as graduate level. Specific suggestions are made concerning the training of future paleobiologists. — DBV

01251 **Beke, G. J.; Pawluk, S.** The pedogenic significance of volcanic ash layers in the soils of an east slopes (Alberta) watershed basin [with French abs.]: Canadian Jour. Earth Sci., v. 8, no. 6, p. 664-675, illus., tables, 1971.

Evaluation of analytical data for a soil described in the field as an Orthic Humo-Ferric Podzol revealed the presence of a paleo-Eutric Brunisol in the lower portion of the solum. A layer of volcanic ash overlying this Brunisolic solum served as a stratigraphic marker for separating the two sola. The IIBfh and IIIBf horizons of the Orthic Humo-Ferric Podzol soil, as described in the field, met the classification requirements for podzolic B horizons. However, the depth to which processes of podzolization appeared active barely included the layer of volcanic ash comprising the IIIBf horizon of the pedon. The development of the pronounced IVBm horizon was ascribed to paleogenesis. — Authors' abstract

08659 **Bell, R. T.** The Hurwitz Group — A prototype for deposition on metastable cratons, *in* Basins and geosynclines of the Canadian Shield (A. J. Baer, editor) — Symposium, Ottawa, 1970, Papers: Canada Geol. Survey Paper 70-40, p. 159-169, illus., table, 1970.

Aphebian rocks of the Keewatin district are described with reference to paleocurrents, depositional phases, and an interpretive sedimentation model. This synthesis and model for the Hurwitz succession, interpreted through a structural and metamorphic veil, is proposed for sedimentation on a metastable cratonic Archean platform, for comparison with those directly on or marginal to stable cratons. Deposition of Hurwitz and Montgomery Lake sediments on the Hudson Protocontinent or metastable craton is represented by a terrestrial basin stage, a stable platform stage, a geosynclinal stage, and an "exogeosynclinal" stage transitional to the Hudsonian orogeny. — DBV

Bence, A. E. *See* Papike, J. J. 01041

01114 **Bence, A. E.; Papike, J. J.** A martini-glass clinopyroxene from the Moon: Earth and Planetary Sci. Letters, v. 10, no. 2, p. 245-251, illus., table, 1971.

A vug clinopyroxene from Apollo 11 igneous rock 10050 is a composite crystal having a tabular pigeonite nucleus upon which pigeonite and augite precipitated simultaneously but on different faces. The result is a martini-glass type of sector zoning when viewed along the b-crystallographic axis. Reconstruction of crystallization sequence is: crystallization of tabular pigeonite nucleus followed by that of subcalcic augite on the (100), (010), and (110) faces while pigeonite continued to grow outward from the nucleus parallel to *c*. As crystallization proceeded, pigeonite composition changed rapidly towards that of augite in unusual trend across the pyroxene quadrilateral. Partition coefficients calculated for the Fe-Mg and $(Ti + 2Al)$-$(R^{2+} + 2Si)$ substitutions are compatible with a preferential incorporation of Fe in pigeonite and $R^{2+}Ti\,Al_2O_6$ in augite in the initial stages. — *from* Authors' abstract

01331 **Bennett, Harold J.; Welborn, Lawrence E.** Application of sensitivity and probabilistic analysis methods to mineral deposit evaluation, *in* Council of Economics, Proc., [V. 6] — AIMMPE, Ann. Mtg., New York, 1971 [Papers]: [New York] Am. Inst. Mining, Metallurgical and Petroleum Engineers, p. 165-223, illus., tables, 1971.

This paper describes the applications of sensitivity and probabilistic analysis methods in evaluating a potential investment in a mineral deposit from the initial exploratory phase through production. Numerous factors are analyzed to determine the most feasible mining and processing method and production rate. The analysis methods are briefly described and are then combined to interrelate mineral reserves, capital

investments, operating costs, and production rates. Results are presented as discounted-cashflow rates of return. For illustrative purposes the evaluation of a mineral deposit was performed using alternative mining and processing methods at different grades, quantities of resources, production rates, and prices. The computer program was written in FORTRAN II and designed for use on computers having a minimum 8,000-word core memory. — *from* Authors' abstract

Bennin, Robert. *See* Brier, Chester. 08559

08695 **Benson, Carl S.** Comparative snow studies on the Antarctic and Greenland ice sheets, *in* Internat. Symposium on Antarctic Glaciological Exploration (ISAGE), Hanover, N.H., 1968 [Proc.]: Internat. Assoc. Sci. Hydrology (and Sci. Comm. Antarctic Research) Pub. 86, p. 242-253, illus., tables, 1970.

In snow stratification, exposed on tunnel walls during construction of New Byrd Station, Antarctica, the rate of accumulation changed from about 20 g cm^{-2} yr^{-1} between 1947 and 1954 to about 14 g cm^{-2} yr^{-1} from 1955 to 1961. This variation could be caused by a migrating surface topography which produces a variable rate of accumulation at a given station, even though the rate of snowfall remains constant. This may be an important complication in interpretation of cores from deep drilling. The facies parameters are compared with six stations on the Greenland Ice Sheet which have comparable mean annual temperatures and rates of accumulation. The similarities and differences in the upper 6 m of snow strata, at stations in both areas, are interpreted from differences in wind action and range of temperature; the windier Byrd Station and smaller temperature range favor the development of harder, higher density snow. — GDC

Bergeron, R. *See* Pourret, G. 08562

Bergeron, R. *See* Dimroth, E. 08629

01028 **Berggren, W. A.** Oceanic micropaleontology, *in* U.S. National Report, 1967-1971, Fifteenth General Assembly, IUGG, — Oceanography: EOS, v. 52, no. 6, p. IUGG 249-256, 1971.

The past four years have witnessed an explosive outburst of information in micropaleontology. This summary considers some of the more important contributions: strong support for the sea-floor spreading hypothesis; dating of seismic horizon "A" as late Early Eocene to early Middle Eocene; formulation of a radiolarian biostratigraphic zonation for the Middle to Late Tertiary siliceous sediments, keyed to schemes based on planktonic foraminifera and calcareous nannofossils; understanding of regional biogeographic distribution patterns of various fossil groups and preliminary delineation of paleocirculation patterns of the oceans; and understanding the paleoenvironment of sediment deposition in the Atlantic during Late Mesozoic and Cenozoic. A 2-1/2-page bibliography is given. — DBV

Bergström, Stig M. *See* Sweet, Walter C. 08509

Bermúdez, Pedro J. *See* Seiglie, George A. 01211

01047 **Bernard, Claude.** Addenda á une bibliographie sur les montérégiennes [Addenda to a bibliography on the Monteregian Hills]: Rev. Géographie Montréal, v. 25, no. 2, p. 169-172, 1971.

This addendum to "A bibliography of Monteregian Hills," by Gaston Pouliot, which was included in the guidebook to the Monteregian Hills published for the annual reunion of the Geological Association of Canada and the Mineralogical Association of Canada, held in Montreal in June 1969, contains 79 references on petrographic and mineralogic aspects of the area. — EH

01112 **Bernard, Claude.** Les marques sous-glaciaires d'aspect plastique sur la roche en place (p-forms) — Observations sur la bordure du bouclier canadien et examen de la question (1)]Plastically scoured subglacial marks on bedrock (p-forms) — Observa-

tions along the edge of the Canadian Shield and review of the question (with French, English and Swedish abs.)]: Rev. Géographie Montréal, v. 25, no. 2, p. 111-127, illus., 1971.

The paper points out various relationships of plastic moulding forms with other small-size glacial and glaciofluvial erosional features. Cuspate, ovaloid or curved marks such as scallops, channels, bowls and sickle-troughs (Sichelwannen) have been given quite a few interpretations amongst which soaked ground moraine scouring and glaciofluvial cavitation seem most probable explanations. P-forms, such as sickle-troughs have been rarely mentioned in the literature. This paper reveals that p-forms occur in numerous places of northeastern North America; many occurrences seem to have been misinterpreted as direct abrasion by ice and debris. Typical p-forms are less abundant than other types of glacial microforms; presumably many have been reshaped by abrasion or transformed by meltwaters. In many instances p-forms are striated and scoured due to ice readvance; p-form orientation conforms with the direction of ice movement. — *from* Author's abstract

08500 **Berry, W. B. N.** On teaching stratigraphic paleontology — The application of paleontology in earth history, *in* Teaching paleontology — North Am. Paleont. Convention, Chicago, Ill., 1969, Proc., Pt. A: Lawrence, Kans., Allen Press, p. 12-22, 1970.

The steps leading toward synthesis of earth history should be covered in any presentation of stratigraphic paleontology. Same examples of syntheses should be included. The stratigraphic paleontologist deals with an interlocking set of relationships. The basic data are fossil occurrences; the process of interpreting fossils are those of successive approximations and refinements. The progressive refinements, which commonly result from fresh inquiries into ecology, evolution, and biogeography of organisms, are the goals of the future in stratigraphic paleontology. — DBV

Bickford, M. E. *See* Church, Stanley E. 01394

01088 **Bienlewski, Carl L.; Persse, Franklin H.; Brauck, Earl F.** Availability of uranium at various prices from resources in the United States: U.S. Bur. Mines Inf. Circ. 8501, 91 p., illus., tables, 1971.

The quantities of uranium recoverable from resources in several types of geologic occurrence and analyses of the costs of recovery are compiled mostly from published sources. At the start of 1969 about 161,000 tons of U_3O_8 were estimated to be available at eight dollars per pound from deposits of the types being mined. In addition, uranium available and the costs of recovering it from lower-grade resources include: 30,000 tons of U_3O_8 potentially available from copper leach solutions during a 30-year period at prices up to eight dollars per pound; 85,000 tons of U_3O_8 at 10.18 dollars per pound from Florida and Western phosphate rock treated to produce wet-process phosphoric acid; and 2,557,000 tons of U_3O_8 from 71 billion tons of Chattanooga shale at 69.32 dollars per pound. — APB

01044 **Bieri, Rudolf H.** Dissolved noble gases in marine waters: Earth and Planetary Sci. Letters, v. 10, no. 3, p. 329-333, illus., 1971.

Supersaturation of neon in southeastern Pacific deep sea water is unexpectedly high, 6.6 percent on the average, while surface waters have values about a factor of two lower. A comparison of neon and argon concentrations indicates presence of injected air in deep water. Results from surface samples cannot be reconciled with air injection. Helium in deep water is supersaturated by 11.8 percent, of which 8.5 percent must be attributed to an air injection mechanism. The difference, an excess of 3.3 percent, may reflect an influx of helium from the interior of the Earth. In contrast, the few available data from the deep Atlantic Ocean and from Drake Passage show the supersaturation of helium can be accounted for through air injection alone. — *from* Author's abstract

Biggar, J. W. *See* Erh, K. T. 01272

08539 **Bingham, J. W.** Several probable source vents for the Roza and Priest Rapids type basalts in Whitman and Adams Counties, Washington, *in* Columbia River Basalt Symposium, 2nd, Cheney, Wash., 1969, Proc.: Cheney, Eastern Washington State College Press, p. 171-172, 1970.

Information is presented on vent features observed in flows of the Yakima Basalt. Some were unnoticed heretofore because of their low relief; others were interpreted as cinder cones. It is hoped that others will carry out more thorough study and mapping of these features. — DBV

Bird, John M. *See* Dewey, John F. 01076

Bird, John M. *See* Dewey, John F. 08665

Bishop, W. Don. *See* Youmans, A. H. 01105

Blacet, P. M. *See* Anderson, C. A. 01100

Black, D. I. *See* Stacey, A. P. 01187

01130 **Blackwell, David D.** Heat flow, *in* Tectonophysics, U.S. National Report, 1967-1971, Fifteenth General Assembly, IUGG: EOS, v. 52, no. 5, p. IUGG 135-139, illus., 1971.

This is a summary and bibliography of recent publications of U.S. authors on heat-flow measurements at sea and on land, on thermal properties of various materials, on the early thermal history of the Earth, on the interpretation of heat-flow data. The oceanic heat-flow pattern is explained by various facets of the sea-floor spreading hypothesis. The discovery that heat-flow is linearly related to heat production in plutonic rocks has led to vastly increased understandings of continental heat flow patterns. The first contour map of heat flow in the western United States has been published. — DBV

Bloor, James W. *See* Diamond, Sidney, 08699

08564 **Blumer, M.; Rudrum, M.** High molecular weight fossil porphyrins — Evidence for monomeric and dimeric tetrapyrroles of about 1100 molecular weight: Inst. Petroleum Jour., v. 56, no. 548, p. 99-106, tables, 1970; reprinted in Woods Hole Oceanographic Inst. Ref. No. 70-27, 6 p., tables, 1970.

Vanadyl porphyrin complexes of approximately 1100 molecular weight have been isolated from a Triassic and a Pennsylvanian oil shale by gel permeation chromatography. Adsorption chromatography resolved the pigments into two different structural types. The chromatographic behavior, as well as visible, infrared, and mass spectra, suggest that the less polar group of pigments consists of several homologous series of tetrapyrrole ring monomers with long chain alkyl substitution. The more polar pigments are homologous porphyrin dimers. The geochemical implications and possible application of these findings are discussed. — Authors' abstract

08512 **Boardman, R. S.; Cheetham, A. H.; Cook, P. L.** Intracolony variation and the genus concept in Bryozoa, *in* The genus, a basic concept in paleontology — North Am. Paleont. Convention, Chicago, Ill., 1969, Proc., Pt. C: Lawrence, Kans., Allen Press, p. 294-320, illus., tables, 1970.

A species is a lineage or segment of a lineage representing a series of mutually compatible gene pools, and therefore the boundaries between coeval species are usually nonarbitrary. A genus or other supraspecific term may include one or more lineages arbitrarily grouped in time and space so as to reflect inferred genetic continuity. Supraspecific taxa theoretically can be given evolutionary significance in several ways which are enumerated. Low correlation of characters in many groups of Bryozoa renders a monothetic approach to their classification almost totally arbitrary in the choice of diagnostic character. Polythetic groupings have the additional advantage of stability. It is unlikely that a phenetic approach can be used to approxi-

mate a phylogenetic classification of Bryozoa without consideration of occurrence in time and space as an indication of probable genetic continuity. — DBV

01137 **Bolt, Bruce A.** Structure, composition, and state of the core, *in* Seismology, U.S. National Report, 1967-1971, Fifteenth General Assembly, IUGG: EOS, v. 52, no. 5, p. IUGG 175-178, 1971.

Two major advances in our knowledge of the core and core-mantle boundary since 1967 have been LASA observations of PKiKP reflections from the inner boundary, and growing evidence that there is a low-velocity shell above the mantle-core boundary. Observatory instrumentation, especially the high-gain array facilities, has become more sensitive; previously recondite core phases like PKKKKKP are now regularly observed. Progress on relevant seismic wave theory has been made mainly on the problem of diffraction at the mantle-core boundary; some attention has also been given to the inferential value of the measurements of the gravest terrestrial eigenperoids. — DBV

01171 **Bolt, Bruce A.** The San Fernando Valley, California, earthquake of February 9, 1971 — Data on seismic hazards: Seismol. Soc. America Bull., v. 61, no. 2, p. 501-510, illus., 1971.

Actual faulting in the San Fernando earthquake did not coincide with mapped faults, which is a blow to those who take precise earthquake prediction too seriously. The lesson is that, while clearly active faults must be assigned appropriate risk, zones of risk should not be delineated too sharply mainly on the basis of mapped faults; the type of structure and foundation material must have considerable weight in the risk equation. Much seismological effort following the earthquake was concentrated on important but narrow questions such as magnitude, stress drop, speculations of future earthquakes and aftershock location. The immediate detailed observation of ground and soil movement, building-material and utility behavior, and social response deserves more attention. Damage to various types of structures is described. Recommendations are made concerning hospital construction. — DBV

Boström, Kurt. *See* Veeh, H. Herbert. 01046

Bouldin, D. R. *See* Howeler, R. H. 01271

01198 **Bowman, T. E.** *Palaega lamnae*, new species (Crustacea: Isopoda) from the Upper Cretaceous of Texas: Jour. Paleontology, v. 45, no. 3, p. 540-541, illus., 1971.

Palaega lamnae is described from a single incomplete specimen found associated with the mackerel shark, *Lamna* sp., in the Austin Chalk [north of Dallas]. The specimen is a flabelliferan and is believed to have been a scavenger or possibly a parasite of the shark. — Author's abstract

01328 **Bracey, Dewey R.; Vogt, Peter R.** Plate tectonics in the Hispaniola area — Reply [to discussion by Peter Molnar and L. R. Sykes of 1970 paper]: Geol. Soc. America Bull., v. 82, no. 4, p. 1127-1128, 1971.

For the paper under discussion, *see* ibid., v. 81, no. 9, p. 2855-2859, 1970; Abs. North American Geology, May 1971; discussion ibid., v. 82, no. 4, p. 1123-1126, 1971.

Brady, W. B. *See* Wright-Broughton, C. 08677

01115 **Braitsch, O.** Salt deposits, their origin and composition: New York and Heidelberg, Springer-Verlag (No. 4 *in* Monograph series of theoretical and experimental studies), 272 p., illus., tables, 1971; originally published in German, 1962.

This book, translated from the German by P. J. Burek and A. E. M. Nairn in consultation with A. G. Herrmann and R. Evans, is the most useful single work on the geochemistry of evaporites and is designed for geologists who wish to understand formation of such deposits. The text is in seven sections, most of which include several

sections: introduction, stability conditions of salt minerals, physico-chemical models, natural salt sequences and physico-chemical models, other components of salt deposits, and review. An extensive list of references is included. — VSN

Bramlette, M. N. *See* Bukry, David. 01207

01068 **Brantley, Albert G.** Paleoenvironmental significance of bone orientation in Watkin's quarry (Late Pleistocene), Glynn County, Georgia [abs.]: Georgia Acad. Sci. Bull., v. 29, no. 2, p. 129, 1971.

Brauck, Earl F. *See* Bieniewski, Carl L. 01088

08520 **Bretsky, Peter W.; Lorenz, Douglas M.** Adaptive response to environmental stability — A unifying concept in paleoecology, *in* Evolution of communities — North Am. Paleont. Convention, Chicago, Ill., 1969, Proc., Pt. E: Lawrence, Kans., Allen Press, p. 522-550, illus., 1940.

The concept of adaptive response to changes in environmental stability provides a unified framework for the interpretation of faunal phenomena such as patterns of biotic diversity, community stability, species evolution, and mass extinctions. The state of environmental stability, and its rate and direction of change, would favor the selection of a particular genetic strategy, which then largely determines both ecological and evolutionary characteristics of the species population. Examples are cited. The ecological and genetic responses to changing stability patterns outlined in this paper have suggested a general model which can be tested in the fossil record. The different genetic characteristics to be expected in the species populations comprising the major Paleozoic benthic marine communities, reflecting stable and unstable environments, are enumerated. — DBV

08559 **Brier, Chester; Bennin, Robert; Rona, Peter A.** "Preliminary evaluation of a core scintillation counter for bulk density measurement in marine sediment cores," a reply [to a discussion by V. C. Rose and J. R. Roney, 1970, 1969]: Jour. Sed. Petrology, v. 40, no. 4, p. 1370, 1970.

For the original paper, *see* ibid., v. 39, no. 4, p. 1509-1519, 1969; Abs. North American Geology, June 1970; discussion by Rose and Roney, ibid., v. 40, no. 4, p. 1370, 1970.

01225 **Broadhead, Thomas Webb; Bagby, Robert W.** Chesteran inadunate crinoids from the Floyd Shale, Floyd County, Georgia [abs.]: Georgia Acad. Sci. Bull., v. 29, no. 2, p. 123-124, 1971.

01052 **Broding, Robert A.; Hess, John M.; Wanous, Richard E.** A high-power computer-controlled marine Vibroseis system: IEEE Trans. Geosci. Electronics, v. GE-9, no. 2, p. 90-95, illus., 1971.

A marine Vibroseis system is described that provides for a substantial increase in radiated power. The system is computer-controlled for precise sweep generation, compositing of successive sweeps, and formatting of the tape recording. This increase in radiated power with precision signal generation and recording has demonstrated a survey capability of twice the speed of that previously used. The computer control provides for a soft-wired system that permits optional mode changes and offers means for further automation of positional control with data collection. Onboard monitoring with single-channel continuous correlation provides for a continuous profile plot of any one of 24 recording intervals of the towed hydrophone array. Through diagnostic programs, the system is periodically checked. The system provides for a type-out of the operating log. — Authors' abstract

01036 **Broecker, W. S.; Peng, T.-H.** The vertical distribution of radon in the Bomex area: Earth and Planetary Sci. Letters, v. 11, no. 2, p. 99-108, illus., tables, 1971.

Measurements of the vertical distribution of Rn-222 in the Bomex area [east of Lesser Antilles] yield a number of important pieces of oceanographic information.

They yield a gas exchange piston velocity of 700 m/yr (equivalent to a stagnant boundary layer thickness of 60μ). They allow a limit of greater than 160 cm^2/sec to be placed on the coefficient of vertical eddy diffusion in the 0 to 20 m depth zone and of less than 4 cm^2/sec in the 30 to 40 m depth zone. They also provide a vertical profile of the Ra-226 concentration in sea water. — Authors' abstract

Brooks, C. Kent. *See* Beckinsale, Robert D. 08690

Broussard, W. L. *See* Whiteman, C. D., Jr. 08698

Brown, G. E. *See* Papike, J. J. 01041

08492 **Brown, L. F., Jr.** North Texas (eastern shelf) Pennsylvanian delta systems, *in* Delta systems in the exploration for oil and gas — A research colloquium, Austin, Texas, 1969, Syllabus [No. 1] (W. L. Fisher; L. F. Brown, Jr.; A. J. Scott; J. H. McGowen, leaders): Austin, Texas, Univ. Texas at Austin Bur. Econ. Geology, p. 40-53, illus. [1970?].

Deposition of 1,200 feet (shelf) to 2,500 feet (slope) of Cisco rocks (Pennsylvanian) on the Eastern Shelf in north-central Texas was controlled directly or indirectly by deltaic processes. Studies in progress in the region are aimed at delineating depositional systems, sedimentary processes, and the role played by tectonics, compaction, and paleotopography in controlling depositional sites. This work describes the stratigraphic units involved, the geometry and origin of the deltaic and associated facies, cyclic deposition, a depositional model for a mixed clastic-carbonate province, and factors controlling individual delta sites. — DBV

Brown, L. F., Jr. *See* Fisher, W. L. 08493

08494 **Brown, L. F., Jr.; Fisher, W. L.** Delta systems in other basins, *in* Delta systems in the exploration for oil and gas — A research colloquium, Austin, Texas, 1969, Syllabus [No. 1] (W. L. Fisher; L. F. Brown, Jr.; A. J. Scott; J. H. McGowen, leaders): Austin, Texas, Univ. Texas at Austin Bur. Econ. Geology, p. 67-78, illus. [1970?].

Highlights of delta systems other than the relatively stable and unstable tectonic settings of the North Texas Pennsylvanian and Tertiary Gulf Coast deltas, respectively, are presented here: the Cretaceous of the Western Interior of the United States, Lower Cretaceous of the Alaska North Slope basin, Triassic of the German Basin, and the Upper Paleozoic of the Eastern Interior and mid-continent United States. — DBV

Brown, L. F., Jr. *See* Fisher, W. L. 08570

08542 **Brown, Randall E.** Some suggested rates of deformation of the basalts in the Pasco Basin, and their implications, *in* Columbia River Basalt Symposium, 2nd, Cheney, Wash., 1969, Proc.: Cheney, Eastern Washington State College Press, p. 179-187, illus., 1970.

Rattlesnake No. 1 well in the Pasco Basin, Washington, penetrated about 10,000 feet of stratigraphic section. The oldest basalts encountered are probably Eocene. Long time periods elapsed between flows. A linear rate of flow accumulation (average 1 flow per 500,000 yr) and long, slow, steady basining (1 foot per 5,000 yr) are indicated. Anticlinal uplift began in earliest Pliocene time, accompanying increasing Cascade volcanism and uplift. Slow and long-continued basining explains the presence of an ancestral Columbia River in the Pasco Basin possibly 14 m.y. ago and its periodic reappearance; the distribution of basalt flows and Ellensburg Formation sediments; the transition from the Ellensburg to the Ringold Formation; deposition of the latter; and the completeness of the Basin's stratigraphic section. There is no evidence of major compression or tension. — DBV

01138 **Brune, James N.** Seismic sources, fault plane studies and tectonics, *in* Seismology, U.S. National Report, 1967-1971, Fifteenth General Assembly, IUGG: EOS, v. 52, no. 5, p. IUGG 178-187, 1971.

This is a summary and bibliography of major developments in source mechanism studies in the U.S. since 1967: detailed interpretation of fault solutions in terms of new global tectonics; quantitative estimates of rate of fault slip in earthquakes, their global-tectonics interpretation, and their use in prediction; development of quantitative models of earthquake sources and quantitative interpretation of static deformation measurements in terms of dislocation faulting; demonstration that creep is a major mode of fault slippage; documentation of artificial triggering of earthquakes and verification of complexity in large earthquakes suggesting multiple triggering; studies of earthquake spectrums to obtain source parameters and their variation with magnitude; evidence that small earthquakes represent small fractional stress-drop, stick-slip faulting and larger shocks, large fractional stress-drop deformation. — DBV

01168 **Buchbinder, Goetz G. R.** A velocity structure of the Earth's core: Seismol. Soc. America Bull., v. 61, no. 2, p. 429-456, illus., tables, 1971.

Traveltimes and amplitudes of PKP, P2KP, and higher multiple K phases are determined from worldwide seismograms for one Novaya Zemlya explosion and 7 earthquakes, and from these data a new velocity model is determined for the lowest mantle and core. In this model 132, velocity at the base of the mantle is 13.44 kmps, and the core-mantle boundary is at 2,892 ± 2 km. The PKP caustic in the core is at 143° and the P2KP caustic at ~125°. There is a velocity discontinuity of 0.01 kmps at 4,550 m depth, and a second, of 0.02 kmps, at 4,850 km. The top of the inner core is at 5,145 ± 10 km and represents a discontinuity of 0.576 kmps. Inner core Q is about 400, and outer core Q about 4,000. — DBV

Bucher, J. L. *See* Leisman, G. A. 01193

Buddington, A. F. *See* Hargraves, R. B. 08457

01207 **Bukry, David; Bramlette, M. N.** Validation of *Pedinocyclus* and *Quinquerhabdus*, new calcareous nannoplankton genera: Tulane Studies Geology and Paleontology, v. 8, no. 3, p. 122, 1971.

Names of two new calcareous nannoplankton genera (*Pedinocyclus* and *Quinquerhabdus*) are validated here because generic diagnosis was not given in a previous paper (Bukry and Bramlette, 1969), and because a proposed new genus name, *Leptodiscus*, has been found to be preoccupied by a dinoflagellate. — DBV

01305 **Bukry, David; Percival, Stephen F., Jr.** New Tertiary calcareous nannofossils: Tulane Studies Geology and Paleontology, v. 8, no. 3, p. 123-146, illus., 1971.

Twenty-seven hitherto undescribed Tertiary calcareous nannofossil taxa, from Atlantic and Pacific deep-sea cores and from outcrop localities in North America, are described. Of these, 23 are new species, 3 are new combinations, and one is a new subspecies. — DBV

Bunker, Carl M. *See* Neuschel, Sherman K. 01151

Burley, B. J. *See* Kim, Ki-Tae. 01259

Burley, B. J. *See* Kim, Ki-Tae. 01260

Burn, K. N. *See* Mitchell, R. J. 01217

01232 **Burn, R. G.** Localized deformation and recrystallization of sulphides in an epigenetic mineral deposit: Inst. Mining and Metallurgy Trans., v. 80, sec. B, Bull. 774, p. B116-B119, illus., 1971.

The paragenetic sequence inferable from textural studies of mineral aggregates depends not only on initial sequence of mineral deposition but also on textural effects of subsequent events. Epigenetic galena and sphalerite in the Rio Pis Pis gold-mining district of northeastern Nicaragua have undergone apparently localized deformation and recrystallization resulting from post-ore movements along vein structures.

Polished sections from several different veins containing granular and deformed galena and sphalerite were etched; measurements of the angles of grain boundaries at triple junctions suggest that the deformed galena and sphalerite have been partially annealed. The present *in situ* temperature is below the activation temperature for sphalerite; for galena, however, with a much lower activation temperature, recrystallization may still be taking place. — VMJ

Burns, Roger G. *See* Vaughan, David J. 01070

Burns, Virginia Mee. *See* Vaughan, David J. 01070

Bush, Charles A. *See* Neuschel, Sherman K. 01151

01284 **Butler, J. Robert.** Comparative tectonics of some alpine and southern Appalachian structures: Southeastern Geology, v. 12, no. 4, p. 203-221, illus., 1971.

Major structures along a cross section of the central Swiss Alps are described for comparison with structures and concepts in the southern Appalachians. The Blue Ridge belt in North Carolina must be a thrust sheet, probably rooted just northwest of the Brevard zone, at least near the Grandfather Mountain window. An early (early Paleozoic,) phase of isoclinal folding is recognized in this thrust sheet, in part of the Brevard zone, and over large areas in the Inner Piedmont. A later post-thrusting episode of folding (late Paleozoic) was most intense in the southeastern Blue Ridge belt and probably over most of the Brevard and Inner Piedmont belts. The Brevard zone is probably a great fundamental fracture zone of long and complex history, that may have responded in different ways to changing stress patterns during Paleozoic evolution of the Southern Appalachians. — *from* Author's abstract

08506 **Buzas, Martin A.** On the quantification of biofacies, *in* Computers in paleontology — North Am. Paleont. Convention, Chicago, Ill., 1969, Proc., Pt. B: Lawrence, Kans., Allen Press, p. 101-116, 1970.

Classification of populations into biofacies is regarded as a taxonomic problem. The outcome of any classification depends on the objective for which it is constructed. Comparison of many species distributed over a large area is a formidable task; the computer has removed the drudgery, but requires precise definition of what is to be compared and how to go about it. The precise definition of biofacies is thus contained in the kind of observations made and in the mathematical model used to analyze them. The various quantitative approaches used "successfully" in biofacies analysis are assessed. Their usefulness is in a state of "rough and ready." — DBV

Calandro, A. J. *See* Whiteman, C. D., Jr. 08698

01172 **California Inst. Technology.** (Geol. and Planetary Sci. Div.). Preliminary seismological and geological studies of the San Fernando, California, earthquake of February 9, 1971: Seismol. Soc. America Bull., v. 61, no. 2, p. 491-495, illus., table, 1971.

The San Fernando earthquake, the largest in the Los Angeles area in more than 50 years, has tentatively been assigned a magnitude of 6.6, focal depth of 13.0 km, and epicentral location at 34° 24.0′ N., 118° 23.7′ W. Breaking propagated southward and upward from this point of initial rupture, so that main effects were observed farther south where the fault was shallower and displacement greater. Through February 23, 199 aftershocks with $M \geq 3.0$ had been identified; 26 of these had $M \geq 4.0$. The aftershock sequence appears to be normal. There was no precursory activity. Focuses of 25 aftershocks have been determined; the deepest is at 13 km, with average depth close to 7 km. Distribution of epicenters and surface faulting are shown on sketch maps; fault displacements are described, and a fault plane solution is given for the main shock. The preferred fault plane strikes N 64° W and dips 52° NE; the slip vector in this plane defines movement with a plunge of 45° and rake of 64°. — DBV

Callahan, James E. *See* Wanek, Alexander A. 01089

Calvin, Melvin. *See* Henderson, William. 01358

Cambray, F. W. *See* Watkins, N. D. 01388

Campbell, J. R. *See* Igarashi, Y. 08623

01190 **Campbell, Lyle D.** Occurrence of "*Ogygopsis* Shale" fauna in southeastern Pennsylvania: Jour. Paleontology, v. 45, no. 3, p. 437-440, illus., table, 1971.

A poorly preserved fauna recently discovered in the upper member of the Kinzers Formation near Lancaster, Pennsylvania, is essentially identical to the famous *Ogygopsis* shale fauna from Mt. Stephen, British Columbia. This new fauna contains *Ogygopsis klotzi* (Rominger) and *Olenoides serratus* (Rominger), both of which are common at Mt. Stephen. It also shares with the Stephen Formation faunule seven genera which in the Kinzers Formation occurrence are specifically unidentifiable. This is the first definite report of *Ogygopsis* outside of the Central Cordillera, and the first report of Middle Cambrian fossils from the Kinzers Formation since that of Walcott (1896). — Author's abstract

Caner, B. *See* Lajoie, J. J. 08700

01014 **Carlson, J. E.** Geologic map of the Webbville quadrangle, eastern Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-927, scale 1:24,000, section, text, 1971.

01382 **Carlson, V. A.** Bedrock topography of the Wabamun Lake map-area, NTS 83G, Alberta, west of fifth meridian: [Edmonton, Alberta] Research Council Alberta, scale 1:250,000, 1971.

01220 **Carr, P. A.** Use of harmonic analysis to study tidal fluctuations in aquifers near the sea: Water Resources Research, v. 7, no. 3, p. 632-643, illus., tables, 1971.

Records from 16 days of water level records from a tidal gage and from four wells in a line perpendicular to the shore, were separated by harmonic analysis into three tidal components. In a confined aquifer, ground-water flow obeys linear potential theory so that each component represents a distinct test on an aquifer, which is analyzed for hydraulic conductivity and specific storage. Use of a line of wells permits determination of effective distance and true tidal efficiency by two different plots. Values of hydraulic conductivity agreed closely with values determined by packer tests on nearby wells and permitted examination of composite wave and single well technique. The unseparated composite wave was analyzed by using maxima and minima from four days of records and by assuming a periodicity of 745 min. Calculated values of aquifer parameters differed little from those determined by individual components. — *from* Author's abstract

Carter, Clair. *See* Churkin, Michael, Jr. 01203

01224 **Cassel, D. K.; Nielsen, D. R.** A gamma attenuation unit and logistic system for monitoring water content of large soil columns: Water Resources Research, v. 7, no. 3, p. 731-733, illus., 1971.

A gamma radiation attenuation unit was designed to monitor water content of large cores of natural soil. A logistic system was developed that allows one person easily to maneuver and monitor soil cores as large as 1 ft in diameter and 3 feet in height. — Authors' abstract

01113 **Castle, R. O.; Yerkes, R. F.; Riley, F. S.** A linear relationship between liquid production and oil-field subsidence [with French abs.], *in* Land subsidence, V. 1: Internat. Assoc. Sci. Hydrology Pub. 88 (IASH-UNESCO), p. 162-173, illus. [1971].

Correlations between production and subsidence in the Inglewood oil field of California indicate that subsidence has varied approximately linearly with net liquid production. Similar relations in three Venezuelan fields and the Wilmington (during primary production stage) and Huntington Beach fields in California, suggest that this linearity may be a general phenomenon. The ratio V_s (volume of subsidence)/V_p

(volume of liquid production) ranges from 0.08 in the Inglewood field to nearly 1 in one Venezuelan field. Early production stages commonly have been characterized by non-linearity. If compaction is a linear function of effective stress over the relevant stress range, simple analogy with a tightly confined artesian system indicates that V_p/V_p should remain: constant and close to but >0 for fields with slightly compressible reservoir materials, and constant and close to but <1 for fields with highly compressible reservoir materials. Changes in V_p/V_p through time may be related to changes in the produced gas/liquid ratio. — Authors' abstract

Cavallero, Lillian. *See* Krinsley, David. 08625

Chadbourne, Robert L. *See* Wright, Ruth V. 08696

01226 **Challinor, R. A.** Variations in the rate of rotation of the Earth: Science, v. 172, no. 3987, p. 1022-1025, illus., 1971.

Variations observed in the length of the day can be divided into three types: seasonal, irregular, and long-term. The astronomical data examined here for the years 1956-1969 suggest that the seasonal terms hitherto assumed are slightly in error, that the irregular variations probably share the same source with the seasonal variations, and that the long-term variations may be linked to earthquake activity. — Author's abstract

Chamney, T. P. *See* Wright-Broughton, C. 08677

Channell, J. K. *See* Kruger, P. 08477

Chao, T. T. *See* Gosling, A. W. 01152

08434 **Charre, Roger.** Geology of the Lake Lagacé area—Preliminary report [also French edition]: Quebec Dept. Nat. Resources Prelim. Rept. P.R.-593, 11 p., table, geol. map, 1970.

This swampy area north of Gouin Reservoir has southeastern hills with steep cliffs facing northwest. Glacial deposits cover much of the crystalline Precambrian formations. Distinguished by structural and mineralogical criteria, six rock types are described: amphibolite, biotite gneiss, hornblende gneiss, granodiorite, biotite granite, and gabbro. Deformation had at least two successive stages: first, with apparent north-south direction, isoclinal folds in amphibolites and gneisses, with recrystallization phenomena; the second, trending east-northeast, affected first-stage lineaments, such as axial planes, fold axes, and mineral orientation. Its asymmetric folds, sub-vertical on northwest, are seen at varying scales in southeastern hills. Traces of mineralization are essentially pyrite and pyrrhotite disseminations in metagabbros and fine-grained granodiorite. Results of geochemical analyses are tabulated. — GDC

Cheetham, A. H. *See* Boardman, R. S. 08512

01101 **Chilingar, George V.; Rieke, Herman H., 3d; Sawabini, Costandi T.** Compressibilities of clays and some means of predicting and preventing subsidence [with French abs.], *in* Land subsidence, V. 2: Internat. Assoc. Sci. Hydrology Pub. 89 (IASH-UNESCO), p. 377-393, illus., tables [1971].

Compressibilities of various dry clays were determined experimentally in the laboratory and compared with those of clays saturated with either fresh or sea water. Compressibility ranges from 8.67×10^{-5} to 2.94×10^{-4} at 1,000 psi and from 1.62×10^{-4} to 7.6×10^{-4} psi^{-1} at 100,000 psi. Compaction experiments indicate that salinity of squeezed-out solutions changes with pressure and that mineralization of interstitial waters in shales should be lower than that in associated sandstones if water moves from shale into sand. The salinity of interstitial solutions may reveal the degree of subsequent compaction. Decreasing salinity of produced waters may indicate water influx into sands from associated undercompacted shales. A new technique of electrochemical stabilization of undercompacted formations is offered as a possible solu-

tion to the subsidence problem. Results of experimental work in the laboratory and in the field are presented. — *from* Authors' abstract

01350 **Chipping, David H.** Paleoenvironmental significance of chert in the Franciscan Formation of western California: Geol. Soc. America Bull., v. 82, no. 6, p. 1707-1711, illus., 1971.

It is suggested that the cherts of the Franciscan Formation are biogenic pelagic deposits, formed above rugged volcanic terrains that were possibly close to an oceanic ridge. They may be formed, together with pelagic limestones, as a result of topographic shielding from density currents, and not from direct precipitation of silica from volcanic emanations. The cherts are thought to represent some of the oldest strata on volcanic oceanic basement, and their thin development to indicate a young age for the oceanic plate that was to form the material within the Franciscan mélanges. – Author's abstract

Chorley, Richard J. *See* Haggett, Peter. 08581

08469 **Chown, E. H.; Laurin, A.-F.** Geological reconnaissance of Lac à la Croix area, Chicoutimi and Saguenay Counties [also French edition]: Quebec Dept. Nat. Resources Prelim. Rept. P.R.-588, 7 p., table, geol. map, 1970.

Bedrock of this map-area (no. 1688) consists of two Precambrian Complexes in the Grenville structural province of the Canadian Shield. The anorthositic Blanches mountains, NE-SW, extend the complex of Pambrun Lake area (Chown and Hashimoto, 1965). Exposed rocks are chiefly gneissic anorthosite, amphibolite, and migmatite, considered part of the border facies; some zones of altered gabbroic anorthosite may be distinguished. Structural trends parallel the mountain range; dips are east, steepening near the eastern border. In lowlands east and west of the range are S- to SE-trending, steeply dipping quartz-feldspar-biotite gneisses, covered by Pleistocene glacial debris and glacio-fluvial deposits. Eskers and moraines would provide road-building gravels. Small concentrations of ilmenite in gabbroic anorthosite, and minor disseminated sulfides in the massif may lead to prospecting in southwest-trending valleys. — GDC

08470 **Chown, E. H.** Preliminary report on Geology of Pluto Lake area, Dubuc and Roberval Counties and Mistassini Territory [also French edition]: Quebec Dept. Nat. Resources Prelim. Rept. P.R.-584, 24 p., table, geol. map, 1970.

Archean rocks include synclinal metavolcanic rocks along north front of Otish Mts. and an enclosing gneiss-granite suite under the swampy northern plain. Southward in the Monts Otish Group are two Proterozoic subarkose formations: the lower, pebbly Lac Indicateur, with alternating quartzite; the upper, red argillaceous facies with subgraywacke. Fresh olivine gabbro includes at least three major sills and numerous dikes and connecting sheets, with three perpendicular joint sets. Carbonate-cemented sandstones are most affected by contact metamorphism. Gently dipping rocks are block faulted; southeastern strata tightly folded in an asymmetric anticline overturned to the north. In the central area are extensive ribbed moraines, and in Saguenay valley a broad esker complex. Gabbro and intruded rocks have minor copper mineralization; Lac Indicateur Fm., possibly uranium. Geochemical prospecting analyses are given on geologic map (no. 1703), and tabulated. — GDC

01059 **Chowns, T. M.** Stratigraphy of the Ordovician and Silurian section exposed in the Ringgold road cuts — A proposed geological monument [abs.]: Georgia Acad. Sci. Bull., v. 29, no. 2, p. 123, 1971.

01042 **Chung, D. H.** Pressure coefficients of elastic constants for porous materials — Correction for porosity and discussion on literature data: Earth and Planetary Sci. Letters, v. 10, no. 3, p. 316-324, tables, 1971.

An empirical scheme for correcting porosity effects on pressure coefficients of elastic constants for porous materials is presented. The underlying idea is the recognition of experimental observations that the rate of change of ultrasonic transit-times

with hydrostatic pressure in a porous medium is independent of small porosity at a pressure range of 2-10 kb, a range most commonly utilized in acoustic experiments. The scheme has been successfully tested with two polycrystalline forsterite samples of 1.65 and 6.09 percent porosities, two polycrystalline corundum samples with about 0.3 percent porosity each, and one polycrystalline rutile sample with 0.89 percent porosity. In the light of the present work, most elasticity data obtained on polycrystalline samples may require revision; examples are cited from the literature. — *from* Author's abstract

01394 **Church, Stanley E.; Bickford, M. E.** Spontaneous fission-track studies of accessory apatite from granitic rocks of the Sawatch Range, Colorado: Geol. Soc. America Bull., v. 82, no. 6, p. 1727-1733, illus., tables, 1971.

Igneous rocks from the Sawatch Range, Colorado, known to have a Rb-Sr whole-rock age of 1650 ± 35 m.y. have been dated by the nuclear fission-track method. Analysis gave an age of 50 ± 12 m.y. for some samples of apatite; others gave ages of 183 ± 44 m.y. to 248 ± 68 m.y. Ages of 45 to 50 m.y. agree with the age of Laramide igneous events in the Rocky Mountains and suggest partial to complete annealing of spontaneous fission tracks in the apatites occurred about 50 m.y. ago. For assumed durations of the Laramide annealing event, an extrapolated annealing temperature-time curve for apatite provides minimum temperatures. Rb-Sr ages of minerals from these rocks were not affected by Laramide events; thus, subject to assumptions regarding the duration of the heating, a minimum temperature for Rb-Sr redistribution may be determined. — *from* Authors' abstract

01203 **Churkin, Michael, Jr.; Carter, Clair.** *Hemicricus*, a new name for the tentaculitid genus *Semicyclus* Churkin and Carter: Jour. Paleontology, v. 45, no. 3, p. 556, 1971.

Semicyclus Churkin and Carter, 1970, proposed for a genus of tentaculitids (Mollusca, Cricoconarida) from the Lower Devonian of east-central Alaska (ibid., v. 44, no. 1, 1970), is a homonym; *Hemicricus* is here proposed as a replacement name. — RCD

01196 **Clane, John L.** Paleoecology of trilobites of the Kaibab Limestone (Permian) in Arizona, Utah, and Nevada: Jour. Paleontology, v. 45, no. 3, p. 525-533, illus., 1971.

In the basin of deposition of the Leonardian Kaibab Limestone, trilobites are numerically more abundant and taxonomically more diverse in rocks interpreted as inshore; less abundant and diverse offshore — the reverse of the normal distribution pattern. Inshore species *Anisopyge mckeei* n.sp., *A. inornata* Girty, *Delaria macclintocki* n.sp., and *Vidria, contendens* n.sp. are associated with molluska; offshore species *Delaria macclintocki* and *D. snowi* n.sp. are associated with brachiopods. The paleoecology of this fauna, which includes the youngest well-known occurrence of trilobites over a single large region, provides insight on possible factors underlying the extinction of trilobites. — REG

08516 **Clapham, W. B., Jr.** Evolution of upper Permian terrestrial floras in Oklahoma as determined from pollen and spores, *in* Evolution of communities — North Am. Paleont. Convention, Chicago, Ill., 1969, Proc., Pt. E: Lawrence, Kans., Allen Press, p. 411-427, illus., 1970.

Statistical floristic elements are derived from pollen and spore assemblages from the Flowerpot Formation of Oklahoma, using R-mode product moment correlation followed by ramifying linkage cluster analysis. Two major groups are formed, along with a few intermediate taxa. One of these probably represents the plant community inhabiting upland areas, the other the flora of swampy lowlands which were widespread during the regression but more restricted during normal time of transgression. The same procedure is followed on combined data from the overlying Blaine and Dog Creek Formations; again the same two basic elements emerged. Certain differences indicate that the upland community was evolving. — DBV

08653 **Clark, K. F.** Zoning, paragenesis, and temperatures of formation in the Lordsburg district, *in* Guidebook of the Tyrone-Big Hatchet Mountains-Florida Mountains re-

gion — New Mexico Geol. Soc. Field Conf., 21st, 1970: Socorro, N. Mex., New Mexico Bur. Mines and Mineral Resources, p. 107-113, illus., 1970.

In this mining district, Cretaceous basalt with various intrusions was covered by Tertiary pyroclastics, and cut by later intrusions. Faults and fractures occur in three main sets, with well-developed veins brecciated by repeated movement. Each of six stages of mineralization has distinctive sulfides and gangue. Zoned fluorite is genetically related to a granodiorite stock, and sometime is associated with sulfides. Supergene alteration extends to a depth of 600 feet; secondary minerals coat veins at the surface, and boxworks help define original mineral distribution. In the northern area, hypogene zoning nearly surrounds the stock; in the southern, it is less clearly related to source. Vertical telescoping of core zone, best at Anita mine, indicates shallow mineralization; traces of cadmium in sphalerite suggest high-temperature formation. Copper-tourmaline deposits may be xenothermal. — GDC

01398 **Clark, Malcolm M.** Comparison of SLAR images and small-scale, low-sun aerial photographs: Geol. Soc. America Bull., v. 82, no. 6, p. 1735-1742, illus., 1971.

A comparison of side-looking airborne radar (SLAR) images and black and white aerial photos of similar scale and illumination of an area in the Mojave Desert of California shows that aerial photos yield far more information about geology than do SLAR images because of greater resolution, tonal range, and geometric fidelity, and easier use in stereo. Nevertheless, radar can differentiate some materials or surfaces that aerial photos cannot; thus, they should be considered as complementary, rather than competing tools in geologic investigations. — *from* Author's abstract

Clarke, Frank E. *See* Leopold, Luna B. 01372

08678 **Clarke, Otis M., Jr.; Daniel, Thomas W., Jr.; Szabo, Michael W.** Mineral resources of Wilcox County, Alabama: Alabama Geol. Survey Circ. 66, 26 p., illus., tables, 1970.

Wilcox County is in the Gulf Coastal Plain physiographic province, and the area is underlain by sediments of Late Cretaceous to Holocene ages. Clay occurs in the Porters Creek, Naheola, and Nanafalia Formations. Limestone occurs in the Clayton Formation; lignite occurs in the Oak Hill Member of the Naheola Formation, the Tuscahoma Sand, and the Hatchetigbee Formation; and phosphate-bearing beds occur in the Prairie Bluff Chalk. Sand and gravel suitable for construction aggregate occur in alluvium and high terrace deposits. About 100 feet of salt has been penetrated in an oil-test hole at a depth of 8,150 feet. — Authors' abstract

01124 **Clayton, Robert N.** Stable isotope geochemistry, *in* Volcanology, Geochemistry and Petrology, U.S. National Report, 1967-1971, Fifteenth General Assembly, IUGG: EOS, v. 52, no. 5, p. IUGG 106-110, 1971.

This is a summary and bibliography of works on stable isotope geochemistry published in 1967-70, covering reviews, theoretical and experimental studies, hydrosphere, hydrothermal rocks and rock-water interactions, sediments, metamorphic rocks, igneous rocks, lunar rocks and minerals, meteorites, and tektites. — DBV

01169 **Cloud, William K.; Maley, Richard P.** Preliminary comments on strong-motion data from the San Fernando, California earthquake of February 9, 1971: Seismol. Soc. America Bull., v. 61, no. 2, p. 497-498, illus., table, 1971.

There were more than 200 strong-motion seismographs and more than 100 seismoscopes within 75 mi of the reported epicenter of the San Fernando earthquake. Their records make this earthquake one of the most important in history to engineers. Analysis of the records has barely started. Acceleration at the Pacoima Dam, 5 km from the epicenter, is the highest ever recorded, 0.5-0.75 with several high-frequency peaks to 1 g on horizontal components. At Van Norman earth-fill dam, the seismoscope disappeared into the lake when a section of the crest failed, but was recovered with record intact when the lake level was lowered as a safety measure. — DBV

08637 **Cloud, William K.** Strong-motion instrument results, Santa Rosa, California, earthquakes, October 1, 1969, *in* The Santa Rosa, California, earthquakes of October 1, 1969: Rockville, Md., U.S. Coast and Geodetic Survey, p. 64-93, illus., tables, 1970.

Records of 88 strong-motion recording instruments of the U.S. Coast and Geodetic Survey within 75 miles of the epicenters of the Santa Rosa, Calif., earthquakes of October 1, 1969, are analyzed. Results show that at stations built on rock, surface motion was below triggering or recording level of the instruments; at stations on less firm foundation material, small-amplitude surface motion was recorded. The closest instruments were 28 miles from the epicenters. A need exists for a more extensive and improved network of strong-motion recording instruments in northern California. — EH

Coldwell, Keith L. *See* Conlon, Robert J. 01215

01307 **Coleman, Neil L.** Reply [to discussion of 'Flume studies of the sediment transfer coefficient,' 1970, by U. Mohan Rao, 1971]: Water Resources Research, v. 7, no. 3, p. 751-752, 1971.

For the paper under discussion, *see* ibid., v. 6, no. 3, p. 801-809, 1970; Abs. North American Geology, February 1971.

01312 **Coleman, Robert G.** Petrologic and geophysical nature of serpentinites: Geol. Soc. America Bull., v. 82, no. 4, p. 897-917, illus., tables, 1971.

Serpentinites consist predominantly of lizardite, clinochrysotile, and antigorite. The lowest density serpentinites (< 2.55 g/cc) consist mostly of clinocrysotile. Seismic velocities and magnetic susceptibilities of serpentinites are related to degree of serpentinization. Serpentinite is mainly formed by direct hydration of harzburgite, dunite, and lherzolite in the crust. Large alpine-type serpentinites contain brucite and increased in volume during serpentinization, whereas metamorphic and some highly sheared alpine-type serpentinites without brucite apparently were replaced volume-for-volume. The primary peridotites appear to be slabs of oceanic mantle tectonically emplaced in continental margins. — RAL

01157 **Collins, Lorence G.** Manganese and zinc in amphibolites near the Sterling Hill and Franklin mines, New Jersey: Econ. Geology, v. 66, no. 2, p. 348-350, table, 1971.

Data are presented to show that amphibolites west of the Franklin and Sterling Hill zinc mines, New Jersey, could be potential sources for the Mn and Zn in the ore zones. Amphibolites immediately adjoining the ore bodies have not been sheared and recrystallized and are probably not the sources. Chemical analyses, uniformity of mineralogies, and meta 'pillow lava' structures suggest that the amphibolites are volcanic in origin, and support Callahan's (1966) suggestion that zinc ores might have been derived from Zn-bearing fluids from volcanic emanations prior to the complex metamorphism of the area. — VSN

Colvin, John M., Jr. *See* Stearns, Richard G. 08607

Condon, W. H. *See* Hoare, J. M. 01006

Coney, Peter J. *See* Elston, Wolfgang E. 08651

08489 **Conference Field Trip Committee.** An environmental geology field trip road log, *in* Governor's Conf. on Environmental Geology: Colorado Geol. Survey Spec. Pub., no. 1, p. 68-78, illus. [1970,].

This is the guidebook to a field trip planned to provide a summary of the geology of the Denver area. The trip starts from the Brown Palace Hotel, and stops at Ruby Hill, Chatfield Dam (under construction), Green Mountain, Golden, the Tosco oil shale plant at Rocky Flats, Northglenn, and Quinby. The trip is designed to show the uses being made of land in relation to the geologic conditions. It is not a story of geologic hazards and failures in land use, but an exhibition of geology as it is, the assets to be

developed and preserved, and the problem areas with some consideration of solution by thoughtful planning and wise use of available knowledge and technology. — DBV

01215 **Conlon, Robert J.; Tanner, Roy G.; Coldwell, Keith L.** The geotechnical design of the Townline road-rail tunnel [with French abs.]: Canadian Geotech. Jour., v. 8, no. 2, p. 299-314, illus., tables, 1971.

The Townline road-rail tunnel is being constructed beneath the relocation of the Welland canal. Construction is by opencut and cut-and-cover through 80 feet of lacustrine clays and clay tills. The lower stratified zone in the lacustrine clays has a minimum shear strength parallel to bedding in some layers. Stability studies, involving detailed sampling, testing, and correlations with previous landslides, demonstrate that the landslide mechanism involves a long flat failure surface in the stratified zone. The concrete tunnel structure is being founded on gypsiferous dolomite bedrock. An aquifer zone overlying the bedrock is a major source of ground water. The water had to be drawn down during construction and must be controlled throughout the life of the tunnel to provide stability of overburden slopes, and to prevent solution of gypsum. — *from* Authors' abstract

01316 **Connally, G. Gordon; Sirkin, Leslie A.** Luzerne readvance near Glens Falls, New York: Geol. Soc. America Bull., v. 82, no. 4, p. 989-1007, illus., tables, 1971.

The ice margin of the Luzerne readvance extended at least 20 mi into Lake Albany, to the Luzerne Mountain gorge of the Hudson River west of Glens Falls, New York. The type section for the Luzerne readvance is designated as that at the Luzerne Mountain gorge where the Luzerne readvance till occurs, over sands of Glacial Lake Warrensburg, over main Woodfordian till, and over contorted, pre-Woodfordian lacustrine clays. The western margin of the readvance is reconstructed from isolated morainal segments and associated outwash, and from the postulated ice dam for Lake Warrensburg. The Luzerne readvance is pre-Port Huron in age and is correlated with the Gowanda Moraine of western New York, the Valley Heads Moraine of central New York and the Mohawk Valley, and the Burlington drift of Vermont. — *from* Authors' abstract

01356 **Connally, G. Gordon.** Pleistocene mountain glaciation, northern Vermont — Discussion [of paper by W. P. Wagner, 1970]: Geol. Soc. America Bull., v. 82, no. 6, p. 1763-1765, 1971.

For the paper under discussion, *see* ibid., v. 81, no. 8, p. 2465-2478, 1970; Abs. North American Geology, April 1971.

Connor, J. J. *See* Hinrichs, E. N. 01007

Connor, J. J. *See* Hinrichs, E. N. 01008

08523 **Conolly, J. R.; Ewing, M.** Ice-rafted detritus in North Pacific deep-sea sediments *in* Geological Investigations of the North Pacific (James D. Hays, editor): Geol. Soc. America Mem. 126, p. 219-231, illus., tables, 1970.

The distribution of ice-rafted detritus in piston cores (8 to 17 m long) from siliceous oozes in the northwest Pacific indicates that up to six major zones of ice-rafted sediment were deposited during the Brunhes normal epoch. The easily recognizable detritus first appeared after the end of the Gauss magnetic epoch about 2.2 m.y. ago and was relatively rare until about 1.5 m.y. ago, but became particularly abundant during the last million years. The rafted material consists mainly of altered or zeolitized intermediate to basic volcanic rocks and associated sediments rich in volcanic detritus probably derived from the Kurile-Kamchatka-Aleutian arc. The distribution and abundance of the rafted detritus suggests that currents responsible for distribution of icebergs in the Pleistocene were similar to those that exist today. — Authors' abstract

Cook, P. L. *See* Boardman, R. S. 08512

Cooley, M. E. *See* Irwin, J. H. 01182

08511 **Cooper, G. Arthur.** Generic characters of brachiopods, *in* The genus, a basic concept in paleontology — North Am. Paleont. Convention, Chicago, Ill., 1969, Proc., Pt. C: Lawrence, Kans., Allen Press, p. 194-263, illus., 1970.

No general rule can be made relating to generic characters of brachiopods. The major interior features and shell structure determine the family and superfamily assignments. Generic characters of the interior are generally in the ventral valve, less commonly in the dorsal valve. Presence or absence of septa and dental plates and muscle scar pattern constitute generic characters inside the ventral valve. Variations of the brachidium, nature of the cardinal process, and presence or absence of plates supporting the brachial structures often are helpful characters in defining genera. But in the last analysis exterior characters are of immediate importance in making genera. These are highly repetitious, and within the limits of the superfamily may appear in many different stocks. A combination of inside and outside characters, rather than a single one, ultimately differentiates the genus. — DBV

01097 **Copeland, M. J.** Biostratigraphy of some early Middle Silurian Ostracoda, eastern Canada [with French abs.]: Canada Geol. Survey Bull. 200, pt. 1, p. 1-17, illus., 1971.

Early Middle Silurian leperditiid and beyrichiacean (mainly zygobolbid) ostracode assemblages of central and eastern Canada indicate a biostratigraphic succession of faunizones useful in correlation. This succession is equated with the standard ostracode sequence developed in lower Clinton strata of the Appalachian region and represents both easterly-derived (leperditiid) and westerly-derived (beyrichiacean) faunal elements. Stratigraphic distribution of the assemblages is charted for Manitoba, northern Michigan, Lake Timiskaming, James Bay, southern Ontario, Anticosti Island, and the standard sequence. *Zygobolba logani*, n.sp., is described from the Thornloe Formation, Harris township, Ontario; it also occurs at Lake Timiskaming and in northern Michigan. Eight leperditiid and five additional beyrichiacean species, as well as a thlipsuracean and a healdiacean, are discussed briefly and figured. — VMJ

01393 **Copeland, M. J.** Additional Silurian Arthropoda from Arctic and eastern Canada [with French abs.]: Canada Geol. Survey Bull. 200, pt. 2, p. 19-35, illus., 1971.

Eurypterids, phyllocarids, and ostracodes from Silurian strata in the central Canadian Arctic islands may be divided into four temporal assemblages, based partly on Thorsteinsson's (1958) zonation of associated graptolites from the Cape Phillips Formation, Cornwallis Island: 1) a lower, diverse assemblage of eurypterids, including *Erieopterus phillipsensis* n.sp. from Cornwallis Island, of Llandoverian and possibly earliest Wenlockian age; 2) "*Eurypterus fischeri*" assemblage, latest Wenlockian or earliest Ludlovian; 3) *Ceratiocaris cornwallisensis* assemblage, early to middle Ludlovian; 4) an upper, diverse, widespread assemblage of eurypterids and ostracodes, in basal Peel Sound, upper Read Bay, and Sutherland River Formations, probably latest Ludlovian or Downtonian in age. Six eurypterids (three from eastern Canada), one phyllocarid, and two ostracodes are described in this paper, additional to taxa described by Copeland (1960, 1962) and others. — VMJ

08650 **Corbitt, L. L.; Woodward, Lee A.** Thrust faults of Florida Mountains, New Mexico, and their regional tectonic significance, *in* Guidebook of the Tyrone-Big Hatchet Mountains-Florida Mountains region — New Mexico Geol. Soc. Field Conf., 21st, 1970: Socorro, N. Mex., New Mexico Bur. Mines and Mineral Resources, p. 69-74, illus., 1970.

Faults within these mountains, near Deming in Luna County, mark the northern erosional limit of thrusting associated with Laramide deformation of the Mexican Cordilleran geosyncline; yielding was northward toward the foreland along margin of the foldbelt. In view of regional tectonics, thrusts may be encountered throughout the foldbelt even though parts at any one locality may have escaped deformation. Preorogenic rocks are Precambrian to Permian or Mesozoic(?) in age, with Mesozoic syenitic intrusives; much of their structure is masked by faulted Lower Cretaceous(?) conglomerate and the extensive Lobo Formation which rests unconformably on older strata, intrusions, and thrusts. Basin-Range deformation is younger

than Laramide; anomalous minor structures imposed on the foldbelt include folds, thrusts, or gravity-slide plates derived from intrusive doming or block lifting.—GDC

Corey, J. C. *See* Hawkins, R. H. 01270

01273 **Corey, J. C.; Peterson, S. F.; Wakat, M. A.** Measurement of attenuation of Cs-137 and Am-241 gamma rays for soil density and water content determinations: Soil Sci. Soc. America Proc., v. 35, no. 2, p. 215-219, illus., tables, 1971.

A 400-channel pulse-height analyzer was shown to be adequate for determining the attenuation of a collimated gamma beam from a combined Am-241 and Cs-137 source. The method can be used to calculate the water content and soil density of either swelling or nonswelling soils. — Soil brief

08676 **Cory, R. L.; Forster, W. O.; Renfro, W. C.; Nauman, J. W.** Radioactivity of three fresh-water molluscs of the tidal Columbia River and their associated sediments, *in* Hydrobiology, 'Bioresources of shallow water environments' — Am. Water Resources Assoc. Symposium, Miami Beach, Florida, 1970, Proc.: Illinois, Urbana, American Water Resources Assoc., p. 162-172, table, 1970.

Levels of radioactivity in fresh-water mollusks and associated sediments, and the relation between sediment characteristics and species distribution were examined in the tidal Columbia River. Principal source of radionuclides is the Hanford reactors about 350 mi upstream from Astoria, Oreg. The most common radionuclides are those from fallout, Zn-65, and Cr-51. Three mollusks species differed significantly from each other: for Zn-65 and Cr-51, *Corbicula fluminea* greater than *Anodonta wahlamatensis* greater than *A. oregonensis*; both *Anodonta* contain M-54 with no significant difference in amount. In total metal, Zn was present in all in the same order as Zn-65; both *Anodonta* contained more Mn than did *C. fluminea*, but there was no significant difference in amount of Cr. Mollusks were many times more radioactive than sediments; since their total biomass is minuscule in comparison to sediment mass, their role in transport and deposition of radionuclides is minimal. — VSN

01142 **Cox, Allan; Opdyke, Neil.** Geomagnetic reversals and long-period secular variation, *in* Geomagnetism and paleomagnetism, U.S. National Report, 1967-1971, Fifteenth General Assembly, IUGG: EOS, v. 52, no. 5, p. IUGG 210-213, 1971.

The highlights of paleomagnetic studies since 1967 include: a more accurate radiometric time scale of geomagnetic reversals in the last 5 m.y., such that all polarity intervals longer than 50,000 years have probably been recognized; intensive study of deep-sea cores, defining this time scale more accurately and extending it back well beyond 5 m.y.; analysis of marine magnetic anomalies in the light of sea-floor spreading, yielding a reversal time scale extending back 70 m.y.; investigation of long-period secular variation within individual polarity intervals. This report is a review and bibliography of all of these subjects except marine magnetic anomalies, which are discussed in a separate report. — DBV

Cox, Allan. *See* Banerjee, Subir. 01144

01085 **Craft, T. F.** Scandium distribution in some southeastern clays [abs.]: Georgia Acad. Sci. Bull., v. 29, no. 2, p. 125, 1971.

01040 **Craig, H.; Weiss, R. F.** Dissolved gas saturation anomalies and excess helium in the ocean: Earth and Planetary Sci. Letters, v. 10, no. 3, p. 289-296, illus., 1971.

Results of solubility measurements for helium and neon in sea water show that neon is actually supersaturated in the ocean. The pattern of He-Ne-Ar saturation anomalies, based on new solubility data, shows an injected 'atmospheric component' in Atlantic surface and deep waters and in Pacific deep waters, ranging from 0.5 to 1 ml of air (STP)/kg sea water. Nitrogen-argon relations in the deep Pacific are also consistent with this effect. In addition to T and P, a third parameter is thus required for the study of saturation anomalies. The magnitude of the injected air fraction accounts for all of the 'excess He' in Atlantic deep water and about 60 percent of the

excess in the Pacific. The non-atmospheric excess He in the Pacific corresponds to an anomaly of 3 percent, presumably radiogenic and primordial helium. — *from* Authors' abstract

08573 **Crain, Leslie J.** Hydrology of delta deposits in glaciated valleys in New York [with French abs.], *in* Symposium on the Hydrology of Deltas, V. 1: Internat. Assoc. Sci. Hydrology-Unesco Pub. 90, p. 29-37, illus., 1970.

Glaciated valleys in southwestern New York contain thin layers of glaciofluvial sand and gravel interbedded in thick sequences of lacustrine material; these sand and gravel layers are important aquifers. Streams that drained the uplands formed deltas in the pro- and post-glacial lakes in the valleys. Most delta deposits are in hydraulic contact with glacial aquifers at depth, and provide areas for recharge and reservoirs for storage of water. Wells that tap the glacial aquifers drain the stored water during summer, and water is replenished by precipitation and stream infiltration during winter and spring. Because of the relation of delta deposits to glacial aquifers, the former have great potential for increasing ground-water yields. Results of these studies apply to other regions in the western part of the state and possibly to many other glaciated areas. — *from* Author's abstract

01263 **Crandell, Kenneth H.** Neal Johnstone Smith (1912-1971): Houston Geol. Soc. Bull., v. 13, no. 10, p. 26-27, portrait, 1971.

01212 **Crawford, C. B.; Johnston, G. H.** Construction on permafrost [with French abs.]: Canadian Geotech. Jour., v. 8, no. 2, p. 236-251, illus., 1971.

Permafrost, or perennially frozen ground, occurs widely throughout the northern half of Canada. Experience has shown that special design and construction techniques are required for building on permafrost in order to avoid disturbing the delicate thermal balance that preserves the frozen ground. The state of knowledge is reviewed with respect to site investigations, foundation designs, water supply and sewage disposal, the construction of transportation facilities, and the influence of surface flooding, drainage and other disturbances on the ground thermal regime. Attention is drawn to an extensive literature and research needs are outlined. — Authors' abstract

01161 **Crittenden, Max D., Jr.; Schaeffer, Frederick E.; Trimble, D. E.; Woodward, Lee A.** Nomenclature and correlation of some Upper Precambrian and basal Cambrian sequences in western Utah and southeastern Idaho: Geol. Soc. America Bull., v. 82, no. 3, p. 581-601, illus., 1971.

Thick sedimentary sequences, including diamictite probably of glacial origin, define an ancient trough over 300 mi long, whose eastern hingeline seems to have coincided roughly with the present "Wasatch line." Correlative rocks are much thinner on the shelf east of the Wasatch line. Deposition in the trough was essentially continuous from late Precambrian into Cambrian time, but was interrupted by uplift and erosion on the shelf to the east. The rocks that were deposited in the trough seem to have been displaced eastward on low angle faults during the Sevier orogeny. — WHN

08684 **Cronon, Bill.** The sandstone caves of Wisconsin: Wisconsin Speleologist, v. 9, no. 3, p. 53-99, illus., 1970.

This report lists and describes caves which occur in sandstones of the Lake Superior group, along the northwest shore of the Wisconsin beach of Lake Superior, the Cambrian group in central and south Wisconsin, and the St. Peter formation which lies directly over the Prairie du Chien dolomite and is exposed in the Driftless and a few other areas. The caves are classified as the erosion class, developed by action of wind, water, frost, or ice on the matrix rock, and the collapse class, which occur near the base of the St. Peter sandstone and which are formed by caverns which originate in the Prairie du Chien dolomite, and migrate upward into the St. Peter formation until the sandstone collapses. Caves of the erosion class are classified in stream-meander, exterior-erosion, and ground water-erosion groups. — EH

01223 **Crosby, James W., 3d; Johnstone, Donald L.; Fenton, Robert L.** Migration of pollutants in a glacial outwash environment, [Pt.] 3: Water Resources Research, v. 7, no. 3, p. 713-720, illus., tables, 1971.

Investigations of the drain field environment in the Spokane Valley of eastern Washington show that very high prevalent moisture tensions, at depth, are related to lack of deep fluid percolation and lateral movement of waste waters is assumed. Downward movement of chemical pollutants cannot be demonstrated but may occur during early stages of drain field operation. Migration of bacteria is restricted to a relative few feet from the leach bed. Routing monitoring of ground-water quality did not at any time produce positive results for coliform bacteria. Neither could chemical quality of ground water be related to drain field operation. Local areas where problems have been associated with septic tanks and drain fields appear to be restricted to marginal valley settings where geologic conditions are vastly different. — *from* Authors' abstract

01164 **Crowson, Henry L.** A method for determining the residual meteoritical mass in the Barringer Meteor Crater: Pure and Appl. Geophysics, v. 85, p. 38-68, illus., tables, 1971.

This paper reviews the historical background of Barringer Meteor Crater and early ideas as to its origin. Estimates for the meteorite mass that formed the crater are tabulated. The possibility that residual meteorite material is present in the crater is examined; gravity, magnetic, and electrical surveys of the crater are discussed; and a method is outlined by which this information can be processed by numerical techniques to include Lagrangian interpolation and least squares analysis, then mapped to grid points of a partial polar grid which overlays the crater. Residual meteoritical mass and depth to the mass can be found by solving a polynomial expression, which connects electrical potential with depth, simultaneously with Newton's Law of Gravitation which connects mass and depth. A solution can be found by using the Newton-Raphson iterative procedure at each grid point. Total mass can be found by numerical integration over the partial polar grid. A method for experimentally verifying the analysis is proposed. — DBV

01257 **Currie, K. L.** A study of potash fenitization around the Brent Crater, Ontario — A Paleozoic alkaline complex: Canadian Jour. Earth Sci., v. 8, no. 5, p. 481-497, illus., tables, 1971.

Fractured and brecciated granitoid gneisses around and within Brent Crater display progressive chemical and mineralogical changes due to metasomatism, culminating in potassic, silica-undersaturated metasomatic rocks. The geometric form, petrography, and chemical trends of the metasomatized rocks are virtually identical to those of the fenite aureole of the Callander Bay alkaline carbonatite complex, suggesting that they result from a fenitization process in which K rather than Na is enriched. The fenitization aureole around the Brent Crater strongly supports an hypothesis of alkaline igneous activity centered on the crater. Although this hypothesis does not rule out the possibility that impact was somewhat involved in formation of Brent Crater, all the phenomena associated with the crater are best explained as a result of explosive alkaline volcanism. — DBV

01336 **Currie, K. L.; Ferguson, John.** A study of fenitization around the alkaline carbonatite complex at Callander Bay, Ontario, Canada: Canadian Jour. Earth Sci., v. 8, no. 5, p. 498-517, illus., tables, 1971.

The chemical changes producing fenitization in the granitoid rocks consisted of the substitution of Na plus another cafemic ion for Si in such a way as to maintain the charge balance. The fenitizing fluid was essentially an NaCl brine with high Fe, Ca, and Mg content. Oxygen fugacity was near 10^{-17} bars, sulfur fugacity near 10^{-12} bars. Main fenitization took place at temperatures slightly above 500°C, and fenitization ceased at about 450°C. Pressures were probably less than 500 bars. The source of the fenitizing solutions was carbonatite, in turn derived from nephelinitic magma. — DBV

Cushman, R. V. *See* Mull, D. S. 01375

Dagan, G. *See* Shamir, U. 01221

08639 **Danes, Z. F.** Gravity results in the state of Washington [abs.], *in* Columbia River Basalt Symposium, 2nd, Cheney, Wash., 1969, Proc.: Cheney, Eastern Washington State College Press, p. 327, 1970.

Daniel, Thomas W., Jr. *See* Clarke, Otis M., Jr. 08678

01275 **Davey, B. G.; Low, P. F.** Physico-chemical properties of sols and gels of Na-montmorillonite with and without adsorbed hydrous aluminum oxide: Soil Sci. Soc. America Proc., v. 35, no. 2, p. 230-236, illus., 1971.

Sols and gels of Na-montmorillonite with adsorbed hydrous aluminum oxide were shown to differ from those without adsorbed hydrous aluminum oxide in viscous behavior and specific heat capacity. The relative partial molar free energy of NaCl in the respective systems was also different. These differences were discussed in terms of the kinds of interactions that could cause them. — Soil brief

08672 **Davey, Roger Jack.** Non-calcareous microplankton from the Cenomanian of England, northern France and North America, Pt. 2: British Mus. (Nat. History) Bull., Geology, v. 18, no. 8, p. 333-397, illus., 1970.

Pt. 2 concludes from Pt. 1 (Davey, ibid., v. 17, no. 3, 1969) the descriptions of dinoflagellate cysts (in Pt. 2, about 38 species, 8 new, in 14 genera, 3 new), and treats acritarchs (27 species, 8 new, in 14 genera, 1 new), and two forms of a green alga. The assemblage (total of 25 species) from the Tarrant County, Texas, samples of nearshore, fine-grained sediments (upper Woodbine-lower Eagle Ford) are all recorded from the Cenomanian of England and France or are cosmopolitan; in Late Cretaceous time, most probably there was free communication of Tethyan forms between Europe and Texas by sea currents. But in the distinctive cold-water fauna from the Regina, Saskatchewan, carbonaceous mudstones of the Colorado Group (about 45 species, 14 new, of which 12 are restricted to Saskatchewan), acritarchs are more common, and the dinoflagellate *Deflandrea* (9 species, 5 new) predominates, though absent from Europe. — VMJ

Davies, David K. *See* Fahlquist, Davis A. 01104

01026 **Davis, W. E.; Kleinhampl, F. J.; Ziony, J. I.** Aeromagnetic and generalized geologic map of the San Antonio Mountains, Nevada: U.S. Geol. Survey Geophys. Inv. Map GP-744, scale 1:125,000, separate text, 1971.

08541 **Dayharsh, Fred L.** Distribution of ring dike-like structures near Odessa, Washington, *in* Columbia River Basalt Symposium, 2nd, Cheney, Wash., 1969, Proc.: Cheney, Eastern Washington State College Press, p. 176-178, illus., 1970.

This paper summarizes results of a reconnaissance survey of the areal distribution of ring dike-like structures in the general vicinity of Odessa, Washington. Their characteristic topographic expression is as arcuate or concentric ridges standing as much as 50 feet above the surrounding terrain, contrasting sharply in form and texture with both the floor covered basalts of channels and the "lizard skin" patterned ground on interfluves between the channels. Individual structures range from 300 to 5,400 feet in diameter. Elliptical forms are common. They occur both singly and in clusters. According to McKee and Stradling (1970), who termed them "sag flowout structures," they are produced by collapse of segments of frozen crust of a flow (caused by withdrawal of magma in the lower part) and forcing up of molten magma from below along arcuate fractures. — DBV

Decker, R. W. *See* Walsh, J. B. 01078

01321 **Deju, Raul A.** A model of chemical weathering of silicate minerals: Geol. Soc. America Bull., v. 82, no. 4, p. 1055-1062, illus., table, 1971.

Laboratory studies of glass beads, soda microcline, spodumene, and forsterite subjected to leaching with HCl-acidified, deionized water, suggested that weathering of

sediments involves largely sorption-desorption processes. The reactions are highly pH dependent and vary with the O:Si ratios of the minerals. Phenomena at the sediment-water interface are conceived as adjustments in the direction of minimal free energy differences between the mineral grains, surface, and external environment. Sorption-desorption phenomena may explain water-quality changes and perhaps play a role in porosity changes. A mathematical model gives expected H^+ sorption for a bed as a function of time and space. — JHF

Delach, M. N. *See* Horn, D. R. 08445

08452 **DelCastillo G., Luis; Mendive A., Lázaro.** Barreras mentales y sus consecuencias en la geofisica de exploración (Mental blocks and their consequences in exploration geophysics): Geología y Metalurgia, v. 5, no. 32, p. 35-44, 1970.

The author proposes an interdisciplinary approach to exploration geophysics, both by individuals and scientific organizations. He reviews the history of geophysics as applied to the petroleum and mining industries and discusses modern geologic technology and how it can be used in geophysical exploration. — EH

08697 **Denechaud, E. B.; Helmke, P. A.; Haskin, L. A.** Analysis for the rare-earth elements by neutron activation and Ge(Li) spectrometry: Jour. Radioanal. Chemistry, v. 6, no. 1, p. 97-113, tables, 1970.

A procedure for analysis of 12 of the rare-earths, tested on more than a hundred samples of rocks and minerals, is described. Carrier is added for each element to be determined. Samples are fused with Na_2O_2. The rare-earths are separated as a group, then precipitated and mounted as oxalates for Ge(Li) spectrometry. Following radioassay, chemical yields for the individual rare-earths are obtained by irradiation and counting of the carrier. About two months are needed to obtain complete data for a set of four samples, but many samples are analyzed concurrently. The precision and accuracy exceed ± 5 percent for 10 of the elements in 0.1 to 0.5 g samples of common rocks. — Authors' abstract

01379 **Denis, E. E.** Ground-water conditions in the Harquahala Plains, Maricopa and Yuma Counties, Arizona: Arizona Land Dept. Water-Resources Rept., no. 45, 44 p., illus., tables, 1971.

In the Harquahala Plains, on the border of Maricopa and Yuma Counties, Arizona, ground water is the only source of supply for irrigation purposes. Irrigation began in 1951, by December 1963 about 33,000 acres of land were being irrigated from about 100 wells, and by December 1966, 39,500 acres were under cultivation with about 120 wells, mostly in the southeastern plains. From December 1963 to December 1966, the water level declined as much as 50 feet in the developed area; about 3.7 million acre-feet of sediments were dewatered by withdrawal of about 560,000 acre-feet of ground water, and about 7.4 million acre-feet of water are available for withdrawal. The dissolved-solids content of well water ranges from 500 to more than 1,000 mg/l, fluoride concentrations are from 1.1 to 6.0 mg/l, and most water is not suitable for drinking. — VSN

Dennen, William H. *See* Moore, Bruce R. 08549

Desborough, George A. *See* Amos, Dewey H. 08496

01076 **Dewey, John F.; Bird, John M.** Origin and emplacement of the ophiolite suite — Appalachian ophiolites in Newfoundland: Jour. Geophys. Research, v. 76, no. 14, p. 3179-3206, illus., 1971.

Ophiolite generation in oceanic ridges and marginal basins, ophiolite emplacement and consuming plate margins, and space-time relations of ophiolites are discussed at some length. In the final section, the ophiolite complexes of western Newfoundland, better developed than any others in the Appalachian-Caledonian orogenic belt, are evaluated in terms of the concepts developed in the preceding sections. The Early Ordovician Newfoundland ophiolites have complex and variable structural relations

with rocks of the Paleozoic continental margin. Immense obducted ophiolite slices carry transported garnet-amphibolites, and are believed to have developed in a marginal basin behind early Paleozoic island arcs on the northwestern (present) margin of a proto-Atlantic Ocean. — DBV

08665 **Dewey, John F.; Bird, John M.** Plate tectonics and geosynclines, *in* The structure of the crust and mantle beneath inland and marginal seas — Internat. Upper Mantle Comm. Upper Mantle Project, Sci. Rept. No. 29: Tectonophysics, v. 10, nos. 5-6, p. 625-638, illus., 1970.

Kay's (1951) classification of geosynclines, involving bulk sedimentary volcanic and tectonic assemblages, is accomodated within the megaframework of oceanic expansion and contraction by lithospheric accretion and consumption. Apparently, entirely continental eugeosynclines do not exist; geosynclines occur in oceans with marginal continental shelves, continental rise, deep ocean basins, small ocean basins and island arcs. An orogen, resulting from crustal loss in trenches at Benioff zones, grows progressively away from the trench, either on the continental margin or as an island arc. The term kinegeosyncline is proposed for the contracting trough, trapped between continental margins and growing orogens. The arrival of a continental mass, with its continental margin sediments, at a trench results in collision and an orogen, which may suture continents together. — Authors' abstract

08472 **DeWiest, Roger J. M.** Hydrology of the Pamlico estuary in the State of North Carolina [with French abs.], *in* Symposium on the hydrology of deltas, V. 2: Internat. Assoc. Sci. Hydrology-Unesco Pub. 91, p. 375-385, illus., tables, 1970.

The hydrologic study of the Pamlico estuary and main underlying aquifer has shown that there is enough natural replenishment to this aquifer to sustain the natural upward leakage from the aquifer into the estuary, in spite of the heavy withdrawal of ground water [at the site of phosphate mines along the estuary]. As a result of this, reversals in the hydraulic gradient of the aquifer flow will only be very localized and limited to the immediate vicinity of the mine. The danger of aquifer contamination by brackish water from the estuary is therefore insignificant. — Author's conclusion

08699 **Diamond, Sidney; Bloor, James W.** Globular cluster microstructure of endellite (hydrated halloysite)[with French, German, and Russian abs.]: Clays and Clay Minerals, v. 18, no. 6, p. 309-312, illus., 1970.

Scanning electron microscope observation of endellite from [source cave at Gardner Mine Ridge near] Bedford, Ind., discloses the existence of globular clusters of quasi-tubular endellite particles radiating from common centers. Individual clusters are of the order of 10μ in overall diameter. The individual quasi-tubular particles are irregularly flattened in cross section, and some may be plugged at the ends. Conventional oven drying at 105°C results in partial unrolling and incomplete flattening of the quasi-tubular particles of some of the clusters. The globular cluster microstructure is taken to represent the result of *in-situ* crystallization from solution. If this is so, these hollow tubes cannot have arisen by the mechanism of repeated extrusion of concentric zonal crystallites as postulated by Chukhrov and Zvyagin [1966]. — Authors' abstract

08693 **Dietz, R. S.; Sproll, W. P.** Overlaps and underlaps in the North American to Africa continental drift fit [with French and German abs.], *in* The geology of the East Atlantic continental margin — ICSU/SCOR Working Party 31 Symposium, Cambridge, England, 1970, [Pt.] 1, General and Economic Papers: [Great Britain] Inst. Geol. Sci. Rept., no. 70-13, p. 143-151, illus., 1970.

Reconstruction of pre-continental drift geography generated by a computer programmed to fit the bulge of Africa against the great bight of North America is presented. Three major areas of misfit are explained: (1) Ifni gap, created by tectonic displacement of the West Canaries block away from the African margin as a sialic microcontinent; (2) Cap Blanc overlap, due to post-drift accretion of a pile of sediments deposited on oceanic crust along the African margin off Cap Blanc; and (3) Bahama platform overlap, a thick sedimentary clastic-carbonate accretionary 'layer

cake' laid down on oceanic crust within a small ocean basin formed shortly after incipient rift opening of the Atlantic in Triassic. The complete closure of the North Atlantic Ocean prior to 200 m.y. ago seems to be a valid continental drift reconstruction such that the universal landmass of Pangaea then existed. — *from* Authors' abstract

08629 **Dimroth, E.; Baragar, W. R. A.; Bergeron, R.; Jackson, G. D.** The filling of the Circum-Ungava geosyncline, *in* Basins and geosynclines of the Canadian Shield (A. J. Baer, editor) — Symposium, Ottawa, 1970, Papers: Canada Geol. Survey Paper 70-40, p. 45-142, illus., tables, 1970.

The Labrador Trough, Cape Smith Belt, and Belcher Fold Belt are erosional remnants of an Aphebian geosyncline surrounding the Superior Province of Quebec (Ungava Craton) in a wide arc open to the south. Its filling, resting on an Archean basement, consists mainly of sedimentary rocks toward the craton and of mafic volcanic and intrusive rocks away from the craton. Only the mainly volcanic zones remain in the Cape Smith Belt and northernmost Labrador Trough. The geosynclinal filling tends to be cyclic. The paleogeography of the oldest formations in the Central Labrador Trough is examined in some detail. The Labrador Trough segment of the Circum-Ungava geosyncline provides one of the best and most complete examples of a Precambrian geosyncline, and is similar to certain Alpine geosynclines. — DBV

01048 **Dionne, Jean-Claude.** Nature lithologique des galets des formations meubles quaternaires de la région de Rivière-du-Loup–Trois-Pistoles, Québec [Lithologic nature of pebbles in Quaternary unconsolidated deposits in the Rivière-du-Loup–Trois-Pistoles area, Quebec (with French, English and Russian abs.)]: Rev. Géographie Montréal, v. 25, no. 2, p. 129-142, illus., tables, 1971.

Unconsolidated Quaternary sediments of the south shore coastal area of the St. Lawrence Estuary are mostly Appalachian in origin from Lower Ordovician sandstone, siltstone, quartzite, slate, quartz, limestone, and conglomerate. Some foreign crystalline elements are observed. Gravel 2 to 6 cm in size from modern or old raised beaches contains respectively 24.3 percent and 13.5 percent crystalline rocks from the Canadian Shield 25 to 40 km from the St. Lawrence north shore. Glacial and fluvioglacial sediments are mostly composed of Appalachian rocks. Till contains 0.3 percent crystalline rocks, while 1.3 percent are found in the St. Antonin frontal moraine, and 1.5 percent in the outwash deposits. Two Late-glacial deltas have 1.8 percent erratics, while till submerged in Post-Glacial times contains up to 5 percent crystalline rocks. The Laurentian glacier contributed only small amounts of crystalline gravel. The relatively high proportion of erratics in beaches and submerged till is attributed to ice drift. — *from* Author's abstract

08544 **Dodds, R. Kenneth.** The age of the "Columbia River Basalts" near Astoria, Oregon, *in* Columbia River Basalt Symposium, 2nd, Cheney, Wash., 1969, Proc.: Cheney, Eastern Washington State College Press, p. 239-269, illus., table, 1970.

Faunal evidence is presented which suggests that the sandstone beds in which the earlier marine "Columbia River Basalts" are found near Astoria, Oregon, correlate best with the Empire Formation (Pliocene) but could be older. The basalt in question is considered to be Upper Miocene to Lower Pliocene. — DBV

01297 **Dollase, W. A.; Peacor, D. R.** Si-Al ordering in nephelines: Contr. Mineralogy and Petrology, v. 30, no. 2, p. 129-134, illus., table, 1971.

Different degrees of Si-Al ordering are demonstrated to exist in nepheline on the basis of five crystal structure refinements on specimens with different geologic origins and laboratory treatments. Disorder increases in the sequence gneissic-igneous plutonic-volcanic nepheline and appears to increase as a result of laboratory heat treatment. The four independent tetrahedral sites can be divided into two pairs with one pair of sites always less ordered than a second pair in a simple regular relationship. — Authors' abstract

Donahue, Jack. *See* Habib, Daniel. 08521

08447 **Donahue, Jessie G.** Pleistocene diatoms as climatic indicators in North Pacific sediments *in* Geological Investigations of the North Pacific (James D. Hays, editor): Geol. Soc. America Mem. 126, p. 121-138, illus., table, 1970.

Three biostratigraphic zones in the late Pliocene-Pleistocene sediments of the North Pacific are defined using diatoms with limited ranges. The extinction of one species is examined; in 5 out of 6 cores it occurs at the lower boundary of the Jaramillo event (.87 to .89 m.y. B.P.). Diatom temperature values (Td values) based on warm and cold water species are calculated so that low Td values indicate lower temperature. The Td values reveal 2 major divisions within the Pleistocene: 2 m.y. to 700,000 yr B.P. is a time of relatively stable Td values; 700,000 yr B.P. to the Recent has a lower average Td value and shows greater fluctuations in the Td curve. One core contains 9 Td value minima in the last 700,000 yr. — *from* Author's abstract

Donaldson, J. A. *See* Fraser, J. A. 08662

Donaldson, J. A. *See* Fraser, J. A. 08664

01338 **Donath, Fred A.; Faill, Rodger T.; Tobin, Don G.** Deformational mode fields in experimentally deformed rock: Geol. Soc. America Bull., v. 82, no. 6, p. 1441-1461, illus., tables, 1971.

The mode of deformation of an oölitic limestone and a marble changes systematically as a function of both confining pressure and total strain. These experimental results of rock deformation define the fields of the individual modes. The fields can be used in the interpretation of natural deformational environments. — AG

Donath, Fred A. *See* Tobin, Don G. 01339

08583 **Donath, Fred A.** Some information squeezed out of rock: Am. Scientist, v. 58, no. 1, p. 54-72, illus., 1970.

A summary of the mechanics of rock flow is given. Fracture vs. flow responses to strain are described, and numerous examples, illustrated by graphs are included. The factors which affect ductility are discussed; they include confining pressure, increased temperature, solutions, and time. The origin and function of kink bands are also examined. — HRC

01282 **Doner, H. E.; Mortland, M. M.** Charge location as a factor in the dehydration of 2:1 clay minerals: Soil Sci. Soc. America Proc., v. 35, no. 2, p. 360-362, illus., 1971.

Swelling clays which have tetrahedral charge have more stable hydrates than those with octahedral charge. The more localized charge resulting from tetrahedral substitution results in stronger interaction of water with the surface oxygen atoms. — Soil brief

Donley, David L. *See* Wendland, Wayne M. 01038

08513 **Dorf, Erling.** Paleobotanical evidence of Mesozoic and Cenozoic climatic changes, *in* Paleoclimatology — North Am. Paleont. Convention, Chicago, Ill., 1969, Proc., Pt. D: Lawrence, Kans., Allen Press, p. 323-346, illus., 1970.

Fossil plants have generally been regarded as among the more reliable criteria for inferring the nature of paleoclimates. The methods used differ according to the nature of the plant used. All inferences based on the plant record are based on the premise that ancient plants lived under essentially the same environmental conditions as their closest living relations. Difficulties in the study of pre-Quaternary climates have been overcome by application of two independent methods: reliance on distinctive morphologic features having climatic implications, and dependence on overall climatic facies of the whole assemblage rather than on one or a few of the component taxa. On the basis of plant record, climates changed from warmer to cooler during the Tertiary. Triassic, Jurassic, and Early Cretaceous climates were more uniform and warmer than at present, with minor reversals toward cooler or drier conditions. — DBV

01241 **Douglas, Dale.** Midwest fossils — Pt. 13, Fossil plant remains: Earth Sci., v. 24, no. 3, p. 141-146, illus., 1971.

Random specimens of Paleozoic and Pleistocene plant fossils are found occasionally in glacial drift. Impressions of deciduous tree leaves are found in calcareous tufa at Bear Cave along the west bank of the St. Joseph River. Fossil plants are also found in the shale quarries in the Grand Ledge area, Mich., in the Pennsylvanian Saginaw Formation. The Mazon Creek-Braidwood locality in Illinois is world famous; most fossils being found in ironstone concretions. Coal-age plant fossils are found in the Terre Haute area, Ind. Plant fossil deserving special mention are *Lepidodendron*, *Sigillaria*, *Stigmaria*, *Calamites*, *Callixylon*, and fossil algae. — ESL

01027 **Drake, Charles L.** Marine geophysics, *in* U.S. National Report, 1967-1971, Fifteenth General Assembly, IUGG, — Oceanography: EOS, v. 52, no. 6, p. IUGG 244-249, 1971.

In 1967-70, one of the most productive periods in the relatively short history of marine geophysics, a considerable body of data was collected that pertains to the properties, structures, and history of the oceanic areas. The new global tectonics concept was greatly strengthened through the addition of new data of many types from all the ocean basins and the marginal seas. The period covered the final phase of the Upper Mantle Project. Activities are summarized briefly, and a 3-page bibliography is given. — DBV

08556 **Drake, Lon D.** Rock texture — An important factor for clast shape studies: Jour. Sed. Petrology, v. 40, no. 4, p. 1356-1361, illus., tables, 1970.

A systematic relationship exists between the texture of a rock type and the shapes of the fragments produced by fracturing it. In visually isotropic rocks, the percentage of Zingg blades and spheres produced is directly dependent upon the texture, with aphanitic and glassy rocks producing the most blades and coarse-textured rocks producing the most spheres. The proportions of rods and discs are less predictable, perhaps because their basic specifications are the same, as suggested by Smalley's random fracture theory. Weak anisotropy, still visible in hand specimen, has little effect on the shapes of crushed fragments. This study shows the proportions of clast shape that should be produced by the initial breakup of various types of bedrock. Marked deviations from the observed trends may be characteristic of the environment in which the pebbles were later fractured and abraided. — Author's abstract

Duffield, Wendell A. *See* Swanson, Donald A. 01377

01094 **Dunkle, David H.** Notes on an addition to the fish fauna of the Mowry Shale (Cretaceous) of Wyoming: Kirtlandia, no. 14, 8 p., illus., 1971.

A diminutive (28.6 mm) fish specimen, consisting of incomplete skull, 27 articulated vertebrae, and pectoral fin rays, from the middle Cretaceous Mowry Shale near Cody, Park County, Wyo., is described as a previously unrecognized addition to the Mowry fish fauna. The basic organization of morphologic characters suggests tentative assignment to the leptolepiform teleost genus *Clupavus*; specific diagnosis is considered unwarranted at this time because of ignorance of caudal fin structure and other pertinent details. — *from* Author's abstract

Duschatko, Robert W. *See* Pittman, Edward D. 08621

Dutcher, Russell R. *See* Podwysocki, Melvin H. 01149

Dziewonski, A. *See* Porath, H. 01185

01268 **Dziewonski, Adam M.** On regional differences in dispersion of mantle Rayleigh waves: Royal Astron. Soc. Geophys. Jour., v. 22, no. 3, p. 289-325, illus., tables, 1971.

Rayleigh waves generated by the Peru-Bolivian border earthquake of August 15, 1963, have been analyzed at 35 stations in the 150-300 sec period range. Results

prove that Rayleigh wave dispersion measured on world-circling paths shows regional variations. "Purepath" group velocities for shield, oceanic, and tectonic regions appear to confirm that representation of dispersive properties of the upper mantle by three types of regions is justified as a first order approximation of lateral inhomogeneities in the upper mantle. Dispersion curves in this way represent average structures for each type of region, not the actual upper mantle structure for any particular area. Also, any division of the Earth's surface into oceanic, shield, and tectonic regions on the basis of near-surface features seems to be at least partly inconsistent with the topography of deeper discontinuities in the upper mantle. — DBV

Eccles, J. K. *See* Wright-Broughton, C. 08677

08640 **Eddy, P. A.** Geohydrology of the Columbia Basin project area, Washington [abs.], *in* Columbia River Basalt Symposium, 2nd, Cheney, Wash., 1969, Proc.: Cheney, Eastern Washington State College Press, p. 327, 1970.

Edelstein, T. *See* Illiman, W. I. 08686

01402 **El-Ashry, M. T.** Quantitative method for grading drainage density: Geol. Soc. America Bull., v. 82, no. 6, p. 1703-1706, illus., table, 1971.

A numerical scale is suggested to quantify the relative terms, low, medium, and high drainage density. Low density is less than 20 drainageways per sq mi, medium is 40-50, high is more than 80. An additional category, very high (badland), is suggested where there are more than 200 per sq mi. Counts are made by placing a 1 sq mi outline on aerial photographs. Smith's approach to quantification is not adapted to aerial photographs. Horton's approach can be used with modifications. Problems of scale should always be borne in mind. A drainage map prepared from aerial photographs is useful where density is high. — JHF

01095 **Eldredge, Niles.** The allopatric model and phylogeny in Paleozoic invertebrates: Evolution, v. 25, no. 1, p. 156-167, illus., 1971.

The allopatric model of speciation (geographic speciation), although not a strict alternative to gradual divergence, seems to fit the common pattern of nonintergrading species within a lineage as typically preserved in sediments of Paleozoic epeiric seas. The phyletic model is inapplicable to most species preserved in epeiric sediments, as they show no changes in species-specific characters throughout the interval of their stratigraphic occurrence. Instead, changes in such characters are envisioned as occurring relatively rapidly in peripheral isolates. Most new Paleozoic invertebrate taxa probably arose in geosynclines (marginal seas) bordering the cratons; invasion of new taxa into epeiric seas seems directly related to periods of transgression. The subspecies complex of the Middle Devonian trilobite *Phacops rana* in eastern and central North America illustrates, twice in its history, the origin of a new character state in peripheral isolates. — *from* Author's summary

Elliott, James E. *See* Wells, John D. 08465

08651 **Elston, Wolfgang E.; Coney, Peter J.; Rhodes, Rodney C.** Progress report on the Mogollon Plateau volcanic province, southwestern New Mexico — No. 2, *in* Guidebook of the Tyrone-Big Hatchet Mountains-Florida Mountains region — New Mexico Geol. Soc. Field Conf., 21st, 1970: Socorro, N. Mex., New Mexico Bur. Mines and Mineral Resources, p. 75-86, illus., 1970.

The known geology of the Mogollon Plateau is reviewed briefly stressing progress since 1968. In this period of time, the interpretation as a ring-dike complex and of unconformities between the three Datil cycles of eruption are unchanged. Evidence for structural unity is strengthened by tentative recognition from gravity and aeromagnetic data of "framework" and "cauldron" rhyolites. Negative anomalies across the depression were little less than that of the structure as a whole until margins were reached. In re-evaluating new chemical analyses, successive associations became more alkalic as did rhyolitic sequences and major ash-flow sheets within each cycle; high-calcium, two-feldspar tuffs, mostly latites are zoned. Timing of vol-

canism is not related to any known orogeny, nor is the Mogollon Plateau controlled by any known crustal structure. — GDC

08681 **Elston, Wolfgang E.** Volcano-tectonic control of ore deposits, southwestern New Mexico, *in* Guidebook of the Tyrone-Big Hatchet Mountains-Florida Mountains region — New Mexico Geol. Soc. Field Conf., 21st, 1970: Socorro, N. Mex., New Mexico Bur. Mines and Mineral Resources, p. 147-153, illus., 1970.

The thesis that hypogene mineral deposits are related to volcano-tectonic structures, and that methods of identifying them are a powerful exploration tool is defended. A factual summary for Hidalgo County is in the Guidebook of the Society's 16th Field Conference (Elston, 1965); detailed documentation awaits publication. Connection is shown between grabens and volcanic centers in Tertiary rocks, and between volcanic centers and mineral deposits. To carry this principle from the relatively unfaulted edge of the Colorado Plateau into the Basin and Range Province will be difficult, because of ignorance of structures prior to block faulting. There are hints that Laramide porphyries are part of the root system of volcano-tectonic complexes, but nothing yet is known about vent areas of andesites in surrounding basins. — GDC

01162 **Engdahl, E. R.; Felix, C. P.** Nature of travel-time anomalies at Lasa: Jour. Geophys. Research, v. 76, no. 11, p. 2706-2715, illus., table, 1971.

The 1968 P-velocity distribution and a representative core model are used to compute relative Lasa subarray traveltime anomalies for over 600 short-period phases processed by the IBM Seismic Array Analysis Center. Observed phase velocities and computed anomalies for core waves are consistent with a core model in which PKP arrivals following the DEF branch between 145° and 160° are identified with an extension of the BC branch of the caustic curve rather than the Bolt GH branch. Reflected and refracted core phases and diffracted P waves incident to Lasa along common ray paths are found to have nearly identical traveltime anomalies. This phenomenon suggests that the anomalies are not significantly affected by lateral variations that may exist in the lower mantle, core, and source region. Hence the source of observed anomalies must lie almost entirely in the crust and upper mantle beneath the array. — Authors' abstract

Engler, Vivian L. *See* Smith, Merritt B. 01086

01374 **Engman, Edwin T.; Gburek, William J.; Parmele, Leslie H.; Urban, James B.** Scale problems in interdisciplinary water resources investigation: Water Resources Bull., v. 7, no. 3, p. 495-505, illus., tables, 1971.

Problems encountered in estimating scale parameters in interdisciplinary watershed research are discussed. Meteorology, hydrology, geology, and water quality are discussed with respect to their individual strengths and weaknesses when applied to different scale problems. Areas where incompatibilities exist are pointed out, and suggestions are made for effecting compromise. A watershed scale of roughly a hundred acres may be the scale at which all disciplines can effect optimum interaction. — Authors' abstract

01341 **Erdtmann, Berad-Dietrich.** Ordovician graptolite zones of western Newfoundland in relation to paleogeography of the North Atlantic: Geol. Soc. America Bull., v. 82, no. 6, p. 1509-1527, illus., tables, 1971.

Paleontological evidence from structural units of Newfoundland reveals a succession of North American graptolite Zones 1 through 9 (7 not verified). A recently found Early Ordovician *Dictyonema flabelliforme-Staurograptus* at Onion Cove is referred to the mobile belt facies and appears related to similar occurrences in Nova Scotia and western Europe. Most sequences contain graptolites with strong Pacific-American affinities, but one with Baltic-British. Except for a deep-water environment of the Goose Tickle strata, all autochthonous rocks were deposited under sublittoral conditions with sparse graptolites. The beds of the Cow Head allochthonous complex probably came from a rapidly subsiding miogeosyncline shelf between the circumcratonic limestone belt and the mobile belt in the east. A "pre-klippen" reconstruc-

tion of the Cow Head sequence and correlations of the graptolites suggest a "pre-Atlantic rift" belt, graptolites along the "Logan's Zone," and a Baltic faunal development. — *from* Author's abstract

01272 **Erh, K. T.; Nielsen, D. R.; Biggar, J. W.** Two dimensional heat transfer in porous media with steady-state water flow: Soil Sci. Soc. America Proc., v. 35, no. 2, p. 209-214, illus., 1971.

Theoretical and experimental temperature distributions within laboratory columns of soil during steady flow of water in the axial direction show that values of the apparent axial and radial thermal conductivity depend upon the flow velocity for water-saturated conditions. — Soil brief

01139 **Evernden, J. F.** Studies relating to magnitudes of earthquakes and explosions, *in* Seismology, U.S. National Report, 1967-1971, Fifteenth General Assembly, IUGG: EOS, v. 52, no. 5, p. IUGG 187-190, 1971.

This is a summary and bibliography of progress made in 1967-71 in the U.S. pertaining to magnitude of earthquakes and explosions. — DBV

01188 **Evernden, J. F.** Variation of Rayleigh-wave amplitude with distance: Seismol. Soc. America Bull., v. 61, no. 2, p. 231-240, illus., 1971.

Amplitudes of surface waves of both explosions and earthquakes are investigated as a function of distance (0-4000 km). Disagreements with the generally accepted law of amplitude versus distance are noted and discussed. — Author's abstract

Evernden, J. F. *See* Shaw, H. R. 01311

Evernden, J. F. *See* Kistler, R. W. 01384

01079 **Evernden, Jack F.; Filson, John.** Regional dependence of surface-wave versus body-wave magnitudes: Jour. Geophys. Research, v. 76, no. 14, p. 3303-3308, illus., 1971.

The observed regional dependence of surface-wave (M_s) versus body-wave (m_b) magnitudes of underground explosions is due to differences in attenuation of body-waves beneath different source and station sites. The yield of an underground explosion is more easily and accurately estimated from M_s than from m_b. — Authors' abstract

Ewing, John I. *See* VanAndel, Tjeerd H. 01340

Ewing, M. *See* Conolly, J. R. 08523

01302 **Fabbi, Brent P.** X-ray fluorescence determination of barium and strontium in geologic samples: Appl. Spectroscopy, v. 25, no. 3, p. 316-318, tables, 1971.

It is possible to accurately determine barium and strontium in a variety of geologic samples by the X-ray fluorescence method proposed herein after correcting for matrix effects. The first-order (I) titanium K varies as 1 line interferes spectrally with the barium first-order (I) L varies as 1 analytical line. Iron significantly absorbs the emitted strontium X-ray quanta. Both of these effects were investigated in detail and a method of correcting for them developed. Detection limit for both elements is about 10 ppm. — Author's abstract

01186 **Fabiano, E. B.** Magnetic surveys, *in* Geomagnetism and paleomagnetism, U.S. National Report, 1967-1971, Fifteenth General Assembly, IUGG: EOS, v. 52, no. 5, p. IUGG 195-197, 1971.

It is likely that more geomagnetic data have been recorded in the past four years than in any previous four-year interval. Marine measurements have contributed significantly to the newer concepts of sea-floor spreading and continental drift. Airborne

Project Magnet has continued to add substantial numbers of vector field measurements to the world data archives. The Ogo satellites have added a new dimension to the mathematical modeling of the geomagnetic field. The International Geomagnetic Reference Field 1965.0 and a series of magnetic charts referenced to epoch 1970 were derived from data collected by various U.S. agencies. — DBV

01104 **Fahlquist, Davis A.; Davies, David K.** Fault-block origin of the western Cayman Ridge, Caribbean Sea: Deep-Sea Rearch, v. 18, no. 2, p. 243-253, illus., table, 1971.

Analysis of seismic reflection profiles indicates that this portion of Cayman Ridge is a fault block uplifted some 1500 m above Yucatan Abyssal Plain to the north and Bartlett Trough to the south. An asymmetric positive magnetic anomaly of 300 gammas is associated with the southern margin of the Ridge. Its source is interpreted as an igneous intrusion within the block, emplaced prior to or during faulting. Topographic evidence for westward continuation of Cayman Ridge into British Honduras is lacking. A piston core from the northwestern slope of the Ridge revealed 350 cm of *Globigerina* ooze overlying partially cemented, fossiliferous volcanic ash. The ooze is of Oligocene-Recent age, and the faunal assemblages are mixed, indicating slumping. The fossiliferous ash is of early Pleistocene age and may be a blanket over the Ridge, rather than an intrinsic portion of it. — *from* Authors' abstract

Fahrig, W. F. *See* Fraser, J. A. 08662

Fahrig, W. F. *See* Fraser, J. A. 08664

Faill, Rodger T. *See* Donath, Fred A. 01338

Fasham, M. J. R. *See* Stacey, A. P. 01187

Felix, C. P. *See* Engdahl, E. R. 01162

Fenton, Robert L. *See* Crosby, James W., 3d. 01223

Ferguson, John. *See* Currie, K. L. 01336

Feth, J. H. *See* Arnow, Ted. 08427

Filby, R. H. *See* Shah, K. R. 08588

Filson, John. *See* Evernden, Jack F. 01079

08603 **Fischer, Frederick T.; Hoagland, Alan D.** Hydrologic investigations of the Middle Tennessee zinc district, *in* AIME world symposium on mining and metallurgy of lead and zinc, St. Louis, Missouri, 1970 [Proc.] — V. 1, Mining and concentrating of lead and zinc: New York, Am. Inst. Mining, Metallurgical, and Petroleum Engineers, p. 95-107, illus., tables, 1970.

This report summarizes information accumulated to date concerning the Knox aquifer in Tennessee and the conclusions derived therefrom, and discusses additional procedures to provide further data pertinent to Knox hydrology. The artesian nature of the aquifer has been confirmed. — DBV

01175 **Fisher, James R.; Zen, E-An.** Thermochemical calculations from hydrothermal phase equilibrium data and the free energy of H_2O: Am. Jour. Sci., v. 270, no. 4, p. 297-314, table, 1971.

A method is proposed by which thermodynamic parameters of solid phases may be calculated from hydrothermal equilibrium data. A table of Gibbs free energy of H_2O, necessary to calculations, is presented for temperatures between 100 and 1000°C and pressures from 100 to 10,000 bars. This function is calculated from the polythermal 1 atm free energy of formation of steam given by Robie and Waldbaum (1968) and the polythermal, polybaric, volumetrically-derived free energy of H_2O given by Burnham, Holloway, and Davis (1969). Free energy of formation of brucite at

298.15 K and 1 bar, calculated by the proposed method using data of Barnes and Ernst (1963) for the reaction brucite = periclase $+H_2O$, is -200 040 ± 690 cal $mole^{-1}$; this agrees well with accepted, calorimetrically derived free energy values, -199 500 ± 790 cal $mole^{-1}$. — *from* Authors' abstract

Fisher, Richard V. *See* Waters, Aaron C. 08538

Fisher, W. L. *See* Scott, A. J. 08490

08491 **Fisher, W. L.** Gulf Coast Basin Tertiary delta systems, *in* Delta systems in the exploration for oil and gas — A research colloquium, Austin, Texas, 1969, Syllabus [No. 1] (W. L. Fisher; L. F. Brown, Jr.; A. J. Scott; J. H. McGowen, leaders): Austin, Texas, Univ. Texas at Austin Bur. Econ. Geology, p. 30-39, illus. [1970?].

The two basic kinds of delta systems, important in the thick terrigenous fill of the Gulf Coast Basin, are high-constructive (fluvial and fluvially influenced facies) and high-destructive (marine facies). Further delineation of these types is based on specific facies make-up, facies geometry, vertical sequence and pattern, lateral facies distribution, and net sand patterns. Ancient high-constructive delta systems occur in the Lower Wilcox, the Yegua and Jackson of Texas, the Woodbine of northeastern Texas, and the Cotton Valley in the northern part of the Basin. The Mississippi delta is a Holocene analog. Examples are described. Ancient high-destructive delta systems occur in the Upper Wilcox and Frio of Texas and in the Vicksburg of the Texas upper Gulf Coast; all are wave-dominated rather than tide-dominated. Examples are described. — DBV

08493 **Fisher, W. L.; Brown, L. F., Jr.** Delta systems and oil and gas occurrence, *in* Delta systems in the exploration for oil and gas — A research colloquium, Austin, Texas, 1969, Syllabus [No. 1] (W. L. Fisher; L. F. Brown, Jr.; A. J. Scott; J. H. McGowen, leaders): Austin, Texas, Univ. Texas at Austin Bur. Econ. Geology, p. 54-66, illus. [1970?].

In hydrocarbon exploration in terrigenous-filled basins, delta systems and their component facies make excellent targets for oil and gas exploration, in several respects. Examples are given from the Gulf Coast Basin Tertiary and from the north-central Texas (Eastern Shelf) Pennsylvanian and Permian trends. — DBV

Fisher, W. L. *See* Brown, L. F., Jr. 08494

08570 **Fisher, W. L.; Brown, L. F., Jr.; Scott, Alan J.; McGowen, J. H.** (leaders). Delta systems in the exploration for oil and gas — A research colloquium, Austin, Texas, 1969, Syllabus [No. 1]: Austin, Texas, Univ. Texas at Austin Bur. Econ. Geology, p. 1-78, illus. [1970?].

The Colloquium in question included 16 hours of lectures, comprising an introduction to delta systems and deltaic deposition; Gulf Coast Basin Tertiary delta systems; North Texas (Eastern Shelf) Pennsylvanian delta systems; and summation and recapitulation, including discussion of delta systems in other depositional basins. This syllabus is designed to facilitate note-taking and provide a record of the lectures and discussions. It includes a lecture outline, series of brief discussion notes, illustrations, and copies of slides used in the lectures, and selected references on modern and ancient delta systems. — DBV

01246 **Ford, D. C.** Characteristics of limestone solution in the Southern Rocky Mountains and Selkirk Mountains, Alberta and British Columbia: Canadian Jour. Earth Sci., v. 8, no. 6, p. 585-609, illus., tables, 1971.

Temperature, pH, and carbonate hardness of 415 water samples from four limestone areas, covering all major carbonate rock formations of this region and including surface and subsurface examples, show that calcite solute concentrations are greatest in the forest zone, due to CO_2 enrichment in soils. Mixing of waters of karst and non-karst provenance reduces solute concentrations in trunk streams. Karst landforms are uncommon at the surface in alpine forests because blanket deposits of fresh till,

outwash, and colluvium with high carbonate content absorb much of the solutional attack; some substantial caves occur in underlying rock. Solvent capability of tundra waters is less than those of the forest; young solutional landforms are common on many exposures of bare or thinly-mantled limestone. High alpine desert waters have the lowest solvent capability. — VSN

Forster, W. O. *See* Cory, R. L. 08676

Foster, John H. *See* Opdyke, Neil D. 08446

08600 **Fox, Paul J.; Ruddiman, William F.; Ryan, William B. F.; Heezen, Bruce C.** The geology of the Caribbean crust — [Pt.] 1, Beata Ridge, *in* The structure of the crust and mantle beneath inland and marginal seas — Internat. Upper Mantle Comm. Upper Mantle Project, Sci. Rept. No. 29: Tectonophysics, v. 10, no. 5-6, p. 495-513, illus., tables, 1970.

Igneous and sedimentary rocks dredged and cored from this ridge's steep western slope indicate composition, age, and details of crustal evolution of rock-types responsible for recorded compressional wave velocities; sedimentary rock samples also give new data on age and depositional environment of overlying sedimentary reflectors. Deepest (4100 m) are deeply weathered, coarse-grained igneous rocks; in hauls from 4000-2300 m are holocrystalline basalts and diabases with compressional velocities from 5.0-5.6 kmps. At less than 2300 m deep, the Beata Ridge crest is capped by Quaternary deposits upon carbonate sediments of at least middle Eocene age, with shallow shelf faunal assemblages. It is suggested that a 5.4-5.7 kmps crust of basalt and diabase outcrops below 2300 m on a Late Cretaceous-early Tertiary fault scarp; the shallow Eocene shelf subsequently subsided to present depth. — GDC

08507 **Fox, William T.** Analysis and simulation of paleoecologic communities through time, *in* Computers in paleontology — North Am. Paleont. Convention, Chicago, Ill., 1969, Proc., Pt. B: Lawrence, Kans., Allen Press, p. 117-135, illus., table, 1970.

The simulation model was used to test hypotheses regarding the distribution through time of fossil communities in the Richmond Group of southeastern Indiana. A combined hypothesis, including a linear increase in temperature along with marine transgression followed by regression, gave a good general fit to the observed data. The biological factors of frequency, abundance, and aggregation were added to tune the model. The final model provides one possible explanation of the distribution of brachiopods in the upper part of the Richmond Group. It has been expanded to include all the organisms present in the Richmond Group, and the combined depth-temperature hypothesis seems to fit quite well. The next step is to test the model in another area where different environmental conditions gave rise to a different set of fossil distributions. — DBV

08630 **Frarey, M. J.; Roscoe, S. M.** The Huronian Supergroup north of Lake Huron, *in* Basins and geosynclines of the Canadian Shield (A. J. Baer, editor) — Symposium, Ottawa, 1970, Papers: Canada Geol. Survey Paper 70-40, p. 143-156, illus., table, discussion, p. 157-158, 1970.

The Huronian Supergroup of earliest Aphebian age occupies a remnant fold belt about 200 mi long and up to 35 mi wide north of Lake Huron. It comprises up to 40,000 feet of sediments and volcanics dominated by coarse clastic debris deposited in a high-energy environment, alluvial for the most part. The Huronian succession is noteworthy for its pyritic, uraniferous clastic beds and for its three till-like conglomeratic formations. This paper reviews some aspects of the Huronian basin and its contained strata and their special features; interprets environments of deposition of the supergroup, and speculates on the extent of the original area of deposition. It is based mainly on work in the main fold belt, adjacent to Lake Huron. — DBV

Frarey, M. J. *See* Roscoe, S. M. 08633

Fraser, J. A. *See* Hoffman, P. F. 08632

08662 **Fraser, J. A.; Donaldson, J. A.; Fahrig, W. F.; Tremblay, L. P.** Helikian basins and geosynclines of the northwestern Canadian Shield, *in* Basins and geosynclines of the Canadian Shield (A. J. Baer, editor) — Symposium, Ottawa, 1970, Papers: Canada Geol. Survey Paper 70-40, p. 213-238, illus., table, 1970.

This paper summarizes data relevant to the origin and correlation of the redbed deposits (earliest Helikian or late Aphebian) and the overlying Helikian strata of the northwestern Canadian Shield. Data related to the interpretation of tectonic history are emphasized. — DBV

08664 **Fraser, J. A.; Donaldson, J. A.; Fahrig, W. F.; Tremblay, L. P.** Comments [on "The Canadian Shield — A status report, 1970" by F. J. Pettijohn, 1970], *in* Basins and geosynclines of the Canadian Shield (A. J. Baer, editor) — Symposium, Ottawa, 1970, Papers: Canada Geol. Survey Paper 70-40, p. 265, 1970.

Pettijohn (ibid., p. 239-255) considers that deposits of the northwestern Canadian Shield are not geosynclinal in the usual sense, but large residuals of once more extensive, mainly continental sediments. It is important to recall that the Helikian strata in the northwestern shield record deposition in three distinct stages. The similarities between some of these strata and those of the Lake Superior region noted by Pettijohn apply only to the deposits of the first and third stages. Those of the second stage, however, are lithologically mature and include marine carbonates; their pattern of transport indicates that they were not deposited in isolated continental basins and suggests a significant flow of clastic material beyond the present western limits of the Shield. This and other evidence supports the hypothesis that the Helikian sediments of the northwestern Shield represent the eastern margin and platform of a geosyncline. — DBV

08479 **Frebold, Hans.** Pliensbachian ammonoids from British Columbia and southern Yukon: Canadian Jour. Earth Sci., v. 7, no. 2, pt. 1, p. 435-456, illus., table, 1970.

Pliensbachian ammonite faunas recorded from British Columbia and southern Yukon contain *Crucilobiceras, Phricodoceras, Uptonia, Platypleuroceras*?, *Acanthopleuroceras, Tropidoceras, Becheiceras, Amaltheus, Pleuroceras*?, *Prodactylioceras, Dactylioceras,, Arieticeras, Leptaleoceras,* and *Paltarpites*. They indicate the presence of all of the Pliensbachian ammonite zones and most subzones of the northwest European standard section. However, in no single area of western Canada has such a complete succession been established. — Author's abstract

Frederiksen, N. O. *See* Kirkland, D. W. 08576

01378 **Freeman, Paul S.** Clastic diapirism in the Gueydan (Catahoula) Formation, Live Oak and McMullen Counties, Texas: Corpus Christi Geol. Soc. Bull., v. 11, no. 9, 107 p., illus., tables, 1971.

Evidence for clastic diapirism, common to the outcrop area of the Gueydan Formation of South Texas in Live Oak and McMullen Counties includes: mudflow deposits with relic gas vesicles and gasoclasts; relic mud-volcano vents along faults and fractures; erratic deposits of pumice-pebble conglomerates; large igneous blocks and boulders, and carbonate and orthoquartzite blocks; a diapiric, limestone-bearing, serpentine mass; numerous clastic dikes; and deep-seated faults in a region of high-pressure gas reservoirs. Natural gas provided the explosive energy necessary to transport blocks and boulders via gas-filled mudflows from thousands of feet below the surface on which Gueydan sediments were deposited. Diapirism associated with the Mirando-Provident City fault system was still active during deposition of post-Gueydan sediments. — *from* Author's abstract

01228 **Friedman, Irving; Peterson, Norman.** Obsidian hydration dating applied to dating of basaltic volcanic activity: Science, v. 172, no. 3987, p. 1028, illus., 1971.

The obsidian hydration dating technique has been applied to rhyolitic volcanism in the area of Newberry Volcano in Oregon. The technique can be used to date basaltic eruptions when basalt flows and bombs contain remelted rhyolite glass, provided the

basaltic eruptions occurred in the time interval from 200 to 250,000 years ago. Cored bombs give an age of 17,000 ± 2,000 years for the explosive volcanicity at Diamond craters. — DBV

Friedman, Irving. *See* Simpson, E. S. 08432

01155 **Froese, E.** The graphical representation of sulfide-silicate phase equilibria: Econ. Geology, v. 66, no. 2, p. 335-341, illus., 1971.

Oxidation and sulfidation of a particular Fe-Mg silicate is most completely represented by composition contours on a log oxygen fugacity-log sulfur fugacity diagram. Phase relations may be partly expressed in ternary phase diagrams with appropriate restriction, such as constant oxygen fugacity or presence of magnetite. Combining phase diagrams of several Fe-Mg silicates displays phase relations between these minerals and the iron sulfides in a tetrahedron representing a four-component system. Since sulfur is not a constituent of the silicates, phase relations may be adequately shown on one side of the tetrahedron. — *from* Author's abstract

Frye, John C. *See* Leonard, A. Byron. 01361

08571 **Gahr, William N.** Approaches to prevention of water pollution, *in* Governor's Conf. on Environmental Geology: Colorado Geol. Survey Spec. Pub., no. 1, p. 42-49, illus. [1970?].

The soil, or outer crust of the Earth, will probably be the final resting place for most pollutants once they are removed from the air and water. Geologists and planners can provide help in devising solutions to and leadership to carry out solutions to problems of environmental protection. It is the people who must indicate the direction to go, and the public is in much need of dependable technical advice. Examples of public indignation over cases of water pollution are given. Existing controls of water pollution in England, Germany, the United States, and in Colorado in particular, are discussed. The present approach is complicated. A two-region classification of surface water quality in Colorado is proposed. — DBV

08453 **García Gutiérrez, Carlos; Machado Martínez, Luis.** El zoneamiento en los depósitos minerales de La Paz, S.L.P. [Mineral deposit zones of La Paz, San Luis Potosí]: Geologia y Metalurgia, v. 5, no. 32, p. 28-32, illus., 1970.

The mineral deposits of La Paz are associated with faulting in the basement and are related to a metallogenic lineament called Cinturon Oriental which includes deposits of Oaxaca, Pachuca, and other areas. The mineralization is similar to that of most deposits of the Mesa Central of Mexico. It is in an uplifted area, located along a tectonic line and asymmetrically coincident with the intensely folded margins of the uplift. Limestones predominate in the mineralized sedimentary sequence. The lower Tertiary intrusions are more acid. Nonferrous minerals such as copper, lead, and zinc are characteristic. The deposits are in Mesozoic calcareous sediments and are either fissure veins or pyrometasomatic bodies in tactites which form an aureole around monazite quartz intrusives. — EH

08577 **García, Trinidad.** Los mineros mexicanos, 3d edition (José A. García, editor): Mexico, D.F., Editorial Porrua S.A., 386 p., illus., tables, 1970.

This is the third edition of a book originally published in 1895 which includes tales of the discovery of minerals and mines and accounts of the foundation of towns based on the mining and mineral industries. An account of the monetary crisis in Mexico due to the devaluation of silver in the late 1800's is given. In this third edition, the author's nephew, José A. García, has added biographic data on his uncle as well as maps of principal producing mining centers of various minerals and charts of production figures for each mineral by municipality for 1967-68. — EH

01227 **Garlick, G. D.; MacGregor, I. D.; Vogel, D. E.** Oxygen isotope ratios in eclogites from kimberlites: Science, v. 172, no. 3987, p. 1025-1027, illus., tables, 1971.

The oxygen isotope compositions (δ O-18) of eclogitic xenoliths from the Roberts Victor kimberlite range from 2 to 8 per mil relative to SMOW (standard mean ocean water). This surprising variation appears to be due to fractional crystallization: the eclogites rich in oxygen-18 represent early crystal accumulates; the eclogites poor in oxygen-18 represent residual liquids. Crystal-melt partitioning probably exceeded 3 per mil and is interpreted to be pressure-dependent. Anomalous enrichment of oxygen-18 in cumulate eclogites relative to ultramafic xenoliths suggests that crystal-melt partitioning increased after melt-formation but prior to crystallization. — Authors' abstract

01399 **Garner, E. L.; Machlan, L. A.; Shields, W. R.** Standard reference materials — Uranium isotopic standard reference materials: U.S. Natl. Bur. Standards Spec. Pub. 260-27, 150 p., illus., tables, 1971.

This publication describes the work of the Analytical Mass Spectrometry Section of the National Bureau of Standards on the development and characterization of standard reference materials for the isotopic composition of uranium. It provides a group of working standards for developing methods of analyzing uranium, as well as a uniform set of standards with a wide range of isotopic abundances for evaluating, developing, and improving mass spectrometric instrumentation. It discusses the three areas which comprise a complete analytical method for any isotopic measurement: chemistry, instrumentation, and mass spectrometric procedure. — EH

08548 **Gassaway, John D.** Mineral and chemical composition of sediments from the Straits of Florida: Jour. Sed. Petrology, v. 40, no. 4, p. 1136-1146, illus., tables, 1970.

Main sources of sediments are: the Florida Current contributing a low-Mg calcitic biogenic ooze; the Bahama Banks, where highly aragonitic sediments arise; and the relict sediments, the source for the detrital silicates and phosphates. The Miami Terrace reef, with a relatively large high-Mg calcite content, may be a possible fourth source. The mineral suite in the straits is mainly biogenic carbonate except to the northwest where quartz is more than half of the total. Trace elements in the carbonate fraction are in three groups: (a) Sr and Cr have a positive correlation with aragonite and similar quadratic trend surfaces east of the Florida Current axis; (b) Mn and Co vary directly with each other, and they are present in the same phase, and the Florida Current is the principal source for distribution; (c) Fe, Zn, and Cr are correlated with the relict sediments to the northwest where their most probable source is the carbonate-fluorapatite. — *from* Author's abstract

01236 **Gates, Olcott; Powers, Howard A.; Wilcox, Ray E.** Geology of the Near Islands, Alaska, *with a section on* surficial geology, by John P. Shafer: U.S. Geol. Survey Bull. 1028-U, 822 p., illus., tables, geol. maps, 1971.

The Near Islands (Attu, Agattu, Shemya, Alaid, and Nizki), westernmost group in the Aleutian Chain, are composed mainly of volcanic and sedimentary rocks with minor intrusives. The rocks range in age from Mesozoic through early Quaternary, and unconsolidated Quaternary surficial deposits occur on all the islands. No Holocene or historically active volcanoes are present. The islands, rising from the crest of the Aleutian Ridge, carry prominent peripheral wave-cut platforms and shore platforms. Higher parts of the islands have been deeply eroded by glaciers. Structure is dominated by normal and strike-slip faults, and minor folds. — REW

08604 **Gates, William G.** Geology and geological aids to production at the Heath Steele mine, *in* AIME world symposium on mining and metallurgy of lead and zinc, St. Louis, Missouri, 1970 [Proc.] — V. 1, Mining and concentrating of lead and zinc: New York, Am. Inst. Mining, Metallurgical, and Petroleum Engineers, p. 108-122, illus., table, 1970.

The lead, zinc, and copper sulfide deposits in the Heath Steele mine, on the Bathurst-Newcastle area of northern New Brunswick, occur in very fine-grained pyrite and(or) pyrrhotite masses. A consistent spatial relationship to a quartz feldspar porphyry is characteristic of these and similar deposits in the district. The two principal assemblages — pyrite-sphalerite-galina and pyrrhotite-chalcopyrite-pyrite —

occupy characteristic positions relative to the enclosing rocks. This feature and the nature of the sulfide mineralization are described and the variations in metal content are noted, with special emphasis on the lead-zinc ore zones. — DBV

Gburek, William J. *See* Engman, Edwin T. 01374

01177 **Gibb, Fergus G. F.** Crystal-liquid relationships in some ultrabasic dykes and their petrological significance: Contr. Mineralogy and Petrology, v. 30, no. 2, p. 103-118, illus., tables, 1971.

Phase relations, determined at one atm and oxygen fugacity of 10^{-8} atm for rocks from two ultrabasic dikes, are consistent with other petrologic evidence and support mechanical differentiation during intrusion. Crystal-liquid relations during equilibrium crystallization of one rock were determined by electron-probe analysis. Over part of the temperature range where the assemblage olivine + spinel + liquid exists an anomalous relation was found; immediately below liquidus, crystallization is normal with olivine and liquid becoming relatively enriched in iron as temperature decreases. When spinel starts to crystallize iron enrichment in the liquid is suppressed and forsterite content of olivine increases until at lower temperatures a normal trend of iron enrichment is resumed. This phenomenon is attributed to crystallization of spinel under constant oxygen fugacity. — *from* Author's abstract

01045 **Gibb, R. A.** Origin of the great arc of eastern Hudson Bay — A Precambrian continental drift reconstruction: Earth and Planetary Sci. Letters, v. 10, no. 3, p. 365-371, illus., 1971.

The morphologic congruence of the eastern margin of Slave province and the great arc of eastern Hudson Bay suggests that Slave and Superior provinces of the Canadian Shield were once continuous and formed a single protocontinent. The arc reflects the shape of the ancient continental margin of Superior province, formed by continental rupture about 2390 m.y. ago at the end of the Kenoran orogeny which deformed rocks of both Slave and Superior cratons. Early Proterozoic oceanic crust was generated at the axis of a Red Sea-type rift and Slave and Superior plates spread apart. The intervening Churchill Province formed by accretion of new material and coalescence of older crustal fragments during subsequent closure of the postulated Aphebian ocean. The hypothesis could be tested by paleomagnetic measurements and detailed geologic comparisons. — *from* Author's abstract

01056 **Gibbons, A. B.** Geologic map of the Alexandria quadrangle, Campbell and Kenton Counties, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-926, scale 1:24,000, section, text, 1971.

01267 **Gilbert, Freeman.** Excitation of the normal modes of the Earth by earthquake sources: Royal Astron. Soc. Geophys. Jour., v. 22, no. 2, p. 223-226, 1971.

Some century-old results, due to Rayleigh and Routh, are used to derive a very compact and simple representation for the transient response of the Earth to earthquakes. In particular, it is shown how the residual static displacement field is naturally represented in terms of the normal mode eigenfunctions. — Author's summary

01020 **Gildersleeve, Benjamin.** Geologic map of the Nolin Reservoir quadrangle, western Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-895, scale 1:24,000, sections, text, 1971.

08680 **Gillerman, Elliot.** Mineral deposits and structural pattern of the Big Burro Mountains, New Mexico, *in* Guidebook of the Tyrone-Big Hatchet Mountains-Florida Mountains region — New Mexico Geol. Soc. Field Conf., 21st, 1970: Socorro, N. Mex., New Mexico Bur. Mines and Mineral Resources, p. 115-121, illus., 1970.

This Precambrian batholithic complex where exposed is 90 percent granite; it is partly covered by Late Cretaceous sedimentary rocks, Tertiary volcanics, and late Tertiary gravels in valleys. Later intrusions include the quartz monzonite Tyrone

stock with its dominating ore body. Structural elements trend in three directions: northwest—oldest fractures with diabase dikes, and late Tertiary normal faults bounding the mountain block; east-northeast to east — closely spaced fractures, with innumerable dikes and some plugs, earlier than the quartz monzonite; northeast — later block faults and associated fractures. Mineralization can be grouped into three periods: Precambrian, small pegmatites and contact metasomatism associated with batholith; Late Cretaceous or early Tertiary, chiefly base-metal vertically zoned in the Tyrone stock; late Tertiary, fluorite-gold probably related to volcanism, some oxidized copper involving tilted Gila Conglomerate. — GDC

01330 **Gilley, James E.** Environmental cost of mining, *in* Council of Economics, Proc., [V. 6] — AIMMPE, Ann. Mtg., New York, 1971 [Papers]: [New York] Am. Inst. Mining, Metallurgical and Petroleum Engineers, p. 99-109, table, 1971.

The environmental effects of underground and surface mining and of processing minerals or solid fuel, as well as techniques of controlling these effects, are reviewed in terms of cost to the consumer. Mineral-waste utilization and other environmental and pollution control can be achieved by a cooperative effort of industry and government. — EH

08528 **Gilmour, Ernest H.; Stradling, Dale.** (editors). Columbia River Basalt Symposium, 2nd, Cheney, Wash., 1969, Proc.: Cheney, Eastern Washington State College Press, 333 p., illus., tables, 1970.

This volume contains 20 papers presented at the second Columbia River Basalt Symposium conducted by the Northwest Scientific Association, together with 7 abstracts and the field trip map and guide. — DBV

01335 **Glass, Gary B.** Wrench faulting in the Appalachian Plateaus of Pennsylvania: Pennsylvania Geology, v. 2-3, p. 7-11, illus., 1971.

Recent mapping has outlined a 24-mi long zone of intense faulting that fractures mildly deformed late Paleozoic rocks of the Appalachian Plateau in parts of Centre, Clearfield, and adjacent counties, extending northeastward from just north of Altoona to Grassflat. The southeastern termination of faulting coincides with the extreme southeastern outcrop of Pennsylvanian coal-bearing rocks, except for a fault near Tipton which extends beyond the Allegheny Front eastward into Bald Eagle Valley; other faults may extend eastward. The western or northwestern limit is clearly documented in Clearfield County. Mapping has revealed 80 major, steeply-dipping faults striking between N. 5° and 89° W.; their orientation, dip, and sense of movement, classify these as wrench faults. Horizontal offsets range between 1 and 75 feet and vertical a few inches to 600 feet. — VSN

Glass, H. D. *See* Johnson, W. H. 01234

08624 **Gluskoter, Harold J.; Pierard, Louis H.; Pfefferkorn, Hermann W.** Apatite petrifactions in Pennsylvanian shales of Illinois: Jour. Sed. Petrology, v. 40, no. 4, p. 1363-1366, illus., table, 1970.

Phosphate petrifactions of wood have been collected from two separate localities in the Pennsylvanian of Illinois. Optical microscopy, X-ray diffraction, and chemical analyses show that the mineralization is primarily carbonate fluorapatite. One petrifaction is closely associated with nodules and irregular masses of similar fluorapatite composition. The early replacement of wood by carbonate fluorapatite indicates the ready formation of the fluorapatite under some diagenetic conditions and suggests that the origin of at least some of the nodules and irregular masses is not necessarily from coprolites or other organic residues. — Authors' abstract

Goldsmith, Richard. *See* Harwood, David S. 01022

Goles, Gordon G. *See* Osawa, Masumi. 08532

08627 **Goodwin, A. M.; Ridler, R. H.** The Abitibi orogenic belt, *in* Basins and geosynclines of the Canadian Shield (A. J. Baer, editor) — Symposium, Ottawa, 1970, Papers: Canada Geol. Survey Paper 70-40, p. 1-24, illus., discussion, p. 24-30, 1970.

The east-trending Abitibi tectonic unit, the largest (500 by 150 mi) single continuous Archean greenstone belt in the Canadian Shield, is a composite belt featuring mafic to felsic volcanics with coeval intrusions, volcanic sediments, including banded iron formation, and several large granitic batholiths. Metallogenic patterns conform to lithic distributions. Low- to medium-rank greenschist facies prevail. Supracrustal rocks are isoclinally folded about east-trending undulating axes. The belt is truncated abruptly on the east and west. Three main stages of igneous eruption are recognized. Volcanic centers are concentrated in two main east-trending bands covering the northern and southern parts of the belt. The median part of the belt is underlain by uniform tholeiitic basalt, fine-grained clastics, and major batholiths. The Abitibi belt is a remnant of a bilaterally symmetrical intratectonic orogen. — DBV

01152 **Gosling, A. W.; Jenne, E. A.; Chao, T. T.** Gold content of natural waters in Colorado: Econ. Geology, v. 66, no. 2, p. 309-313, illus., tables, 1971.

Neutron activation analysis of 67 samples of water draining from gold-barren and gold-enriched sedimentary, igneous, and metamorphic rocks of the Colorado Front Range reveals a relatively small range in total gold content (nondetectable to 150 nanograms per liter). "Solute" gold concentrations were generally higher than particulate gold concentrations and both were unrelated to rock or water types. The data suggest the occurrence of a spring flush out of "solute" gold in groundwater discharge during the snow-melt recharge period but indicate that direct hydrogeochemical prospecting for gold is unpromising. — Authors' abstract

Goth, Joseph H. *See* Lytle, William S. 08495

Gottfried, David. *See* Phair, George. 01345

01370 **Gould, Stephen J.** The paleontology and evolution of *Cerion* II — Age and fauna of Indian shell middens on Curaçao and Aruba: Breviora, no. 372, 26 p., illus., tables, 1971.

The halophilic pulmonate gastropod *Cerion uva* has been found in great abundance in three Meso-Indian (preceramic) shell middens on Curaçao; radiocarbon ages for 11 shell samples were about 4,000 yr B.P. for all three sites, and charcoal at one site gave a similar date; by comparison, a Neo-Indian midden on Aruba, about 1,500 yr B.P., contained no *Cerion*. Molluscan faunal lists from all sites contain only intertidal and shallow-water species. Almost all *Cerion* shells in the middens have had the apical whorls removed artificially (for eating the animal) and most shells are much larger than any living today. Larger shells might indicate that the now arid climate of Curaçao was moister 4,000 years ago, but there is no other evidence for this. More probably the large shells represent relict populations of snails that had been genetically adapted to the pluvial cycles of the previous glaciation. — VMJ

01301 **Gould, Stephen Jay.** Precise but fortuitous convergence in Pleistocene land snails from Bermuda: Jour. Paleontology, v. 45, no. 3, p. 409-418, illus., table, 1971.

Two convergences between subgenera of Bermudian land snails [*P.* (*Poecilozonites*) and *P.* (*Gastrelasmus*)] were initiated when a taxon of one subgenus evolved to the very different size range of the other. Entrance into this new size range produced or required a set of correlated changes in shape, color, and thickness that resulted in very precise convergences. Some of these ancillary changes were direct adaptations to the new size range; others were fortuitous consequences of growth and its interaction with the developmental rate. Convergence would [not] seem awesome if we recognized: (a) how many characters can be modified together as mechanical or developmental consequences of a primary adaptation; (b) how limited are the adaptive solutions to common problems, in particular to altered size. — *from* Author's abstract

08519 **Gould, Stephen Jay.** Land snail communities and Pleistocene climates in Bermuda — A multivariate analysis of microgastropod diversity, *in* Evolution of communities — North Am. Paleont. Convention, Chicago, Ill., 1969, Proc., Pt. E: Lawrence, Kans., Allen Press, p. 486-521, illus., tables, 1970.

Bermuda is an ideal place to test hypotheses of climatic influence on organic form and diversity. This study deals with 12 species of microgastropods. Four assemblages in Q-mode eigenvectors are recognized for all 48 of the bulk samples used, also in R-mode clusters of species. Environmental interpretation is provided by noting lithologies (and inferred climates) of samples clustering with factor axes and habitat preferences of species that also inhabit North America. Additional evidence is provided by multivariate studies. The utility of this interpretation is apparent in the solution it provides for a major problem in the distribution of a subgenus of Bermuda's outstanding large endemic pulmonate. Climatic influence is further indicated by the discovery that form as well as diversity varies systematically with climate. The most important factor in environmental influence on form and diversity probably is the abundance of calcium carbonate for shell construction. — DBV

01390 **Granger, H. C.; McKay, E. J.; Mattick, R. E.; Patten, Lowell L.; McIlroy, Paul.** Mineral resources of the Glacier Primitive Area, Wyoming: U.S. Geol. Survey Bull. 1319-F, 113 p., illus., tables, geol. map, 1971.

The study area is along the northeast flank of the Wind River Range, and includes the Primitive Area plus an adjoining area to the northwest. The area was mapped, an aeromagnetic survey made, and 593 stream-sediment and 483 rock samples collected. Precambrian crystalline rocks underlie most of the area, and are flanked along the northeast edge by a sequence of Paleozoic marine sedimentary rocks. The north-central part of the area is occupied by the Middle Mountain granitic batholith, 25 mi long and 5 mi wide. This body grades outward into migmatite and agmitite, which grade outward into paragneisses that form the framework of the core of the range. A northwest-trending zone terminates these rocks on the south. No mineral deposits that can be mined economically were discovered; a few mineralized zones of subeconomic grade are described. — *from* Authors' summary

01174 **Grant, James A.; Weiblen, Paul W.** Retrograde zoning in garnet near the second sillimanite isograd: Am. Jour. Sci., v. 270, no. 4, p. 281-296, illus., tables, 1971.

In the migmatitic terrane of Minnesota River valley, gneisses showing retrogression across the second sillimanite isograd are interlayered with others showing no evidence of retrogression. In the latter, only garnet is appreciably zoned, showing low Mn and Fe and high Mg in the core relative to margin. Mn-distribution is the reverse of that commonly reported and is considered due to preferential retention of Mn in garnet during resorption. Decrease in proportion of garnet will occur during retrogression with concomitant decrease in Mg/Mg + Fe ratio. A proposed model involves two simultaneous processes: resorption of initially homogeneous garnet with decrease in Mg/Mg + Fe ratio by preferential loss of Mg, and preferential retention of Fe and Mn in the outer shell of the remaining garnet; decrease with decreasing temperature of radius of outer shell in which compositional changes are effective. — *from* Authors' abstract

Grant, Richard E. *See* Stehli, Francis G. 01194

Grant, Willard H. *See* Prowell, David C. 01062

00997 **Greeley, Ronald.** Observations of actively forming lava tubes and associated structures, Hawaii: Modern Geology, v. 2, no. 3, p. 207-223, illus., 1971.

Observations of active basalt flows in the Upper East Rift Zone of Kilauea, and descriptions of previous flows, permit speculation on mechanisms of lava tube and channel development. Observations were made of fluid basalts erupted in August 1970 from a vent near Alae Crater, and flowing southeast to the sea. Forming exclusively in pahoehoe lava, tubes in general evolve from lava channels. Observations discussed here show that channel crusts and tube roofs form by: (1) accumulation

and thickening of thin surface scums attached to channel sides; (2) accumulation and fusing of flexible, mobile crustal plates; (3) formation of stable, well-defined crusts along channel sides; (4) agglutinization of spattered lava in turbulent flows; (5) accretion of lava toe and lobe crusts at the flow front extending an existing tube. — *from* Author's abstract

01192 **Green, Morton.** Additions to the Mission vertebrate fauna, Lower Pliocene of South Dakota: Jour. Paleontology, v. 45, no. 3, p. 486-490, illus., 1971.

Washing and screening of sediments from the Mission vertebrate local fauna quarry (Clarendonian), near Mission, South Dakota, has produced isolated teeth of forms not previously reported. These are: Soricidae, *Hypolagus*, *Protospermophilus*, *Citellus*, *Perognathus* cf. *coquorum*, *Cupidinimus*, *Eucastor*, Cricetidae, and *Pleisosminthus*. Among large forms, *Aelurodon saevus* is added to the fauna. — Author's abstract

08649 **Greenwood, Eugene; Kottlowski, Frank E.; Armstrong, Augustus K.** Upper Paleozoic and Cretaceous stratigraphy of the Hidalgo County area, New Mexico, *in* Guidebook of the Tyrone-Big Hatchet Mountains-Florida Mountains region — New Mexico Geol. Soc. Field Conf., 21st, 1970: Socorro, N. Mex., New Mexico Bur. Mines and Mineral Resources, p. 33-43, illus., 1970.

This review gives a brief description of Mississippian strata including the Blue Mtn., Ariz., type sections of Keating and Hachita Formations, correlation west of the Rio Grande, and ranges of rugose corals and brachiopods within the Escabrosa Group and Paradise Formation of southwestern New Mexico. Thick to thin Pennsylvanian sequences make up most of the Horquilla Limestone, although the upper part is Permian. No Triassic or Jurassic are known in Hidalgo County, but marine Jurassic strata crop out far to the southeast in Chihuahua [Mexico]. Cretaceous formations in the Hachita area are the Hell-to-Finish, U-Bar, Mojado, and Ringbone apparently deposited into early Tertiary time; Hidalgo volcanic sequence is probably early Tertiary. In Grant and Luna Counties, the Sarten Sandstone, Beartooth orthoquartzite, Colorado Shale, some of beds called Lobo Formation, and thick unnamed units are Cretaceous. — GDC

01265 **Gregersen, Sören.** Surface wave dispersion and crust structure in Greenland: Royal Astron. Soc. Geophys. Jour., v. 22, no. 1, p. 29-39, illus., tables, 1971.

Rayleigh and Love wave group and phase velocity dispersion has been determined for two profiles crossing the interior of Greenland. It was found that the dispersion is similar on the two profiles. The observed dispersion is only a little different from the Canadian Shield dispersion. The observations have been compared with theoretical model dispersion curves. A model G-62 has been developed for the Greenlandic Shield. It is similar to the model for the Canadian Shield. The depth to the Mohorovičic discontinuity appears to be a little greater than in Canada. – Author's summary

01063 **Gregor, Bryan.** Note on the geochemical behavior of acids [abs.]: Georgia Acad. Sci. Bull., v. 29, no. 2, p. 126, 1971.

Griggs, Allan E. *See* Peck, Dallas L. 08534

08703 **Grinenko, V. A.; Thode, H. G.** Sulfur isotope effects in volcanic gas mixtures: Canadian Jour. Earth Sci., v. 7, no. 6, p. 1402-1409, illus., tables, 1970.

In the presence of water vapor sulfur isotope exchange proceeds at an appreciable rate in $H_2S \rightleftharpoons S^o$ above 150°C and in $SO_2 \rightleftharpoons S^o$ at 300°C. The exchange constant for the first approaches unity in the range from 200 to 400°C and constants for the second at 400 to 450°C and equal 1.0095 and 1.0090 respectively, favoring S-34 in the SO_2. The kinetic isotope effect of the reduction of SO_2 to S^o in interaction with H_2S is determined for 25°, 200°, and 280°C, where the $^{32}SO_2$ molecules react 1.6 percent faster than the $^{34}SO_2$ molecules. The spread in isotopic composition of various forms of sulfur in volcanic gases is caused not only by isotope exchange reactions

between oxidized and reduced sulfur but also by kinetic isotope effects in unidirectional reactions which result from major temperature changes at the outflow. — *from* Authors' abstract

01003 **Griscom, Andrew; Muffler, L. J. P.** Aeromagnetic map and interpretation of the Salton Sea geothermal area, California: U.S. Geol. Survey Geophys. Inv. Map GP. 754, scale 1:62,500, profiles, separate text, 1971.

Gross, D. L. *See* Johnson, W. H. 01234

08694 **Gupta, Sujoy.** Miospores from the Desmoinesian-Missourian boundary formations of Texas and the age of the Salesville Formation, *in* Perkins, B. F., editor, Geoscience and Man — V. 1, Proceedings of Am. Assoc. Stratig. Palynologists, Ann. Mtg., 1st, 1968: Baton Rouge, La., Louisiana State Univ., School of Geoscience, p. 67-82, illus., tables, 1970.

Miospore associations from the East Mountain Shale (Late Desmoinesian), the Salesville Shale, and the Keechi Creek Shale (Missourian) of the Upper Pennsylvanian in north-central Texas are compared with Pennsylvanian assemblages from Europe and Canada. The Salesville Shale, which is generally regarded as the earliest Missourian in north-central Texas, has been assigned to the Late Desmoinesian age. It is correlated with the VB2 spore division of eastern Canada, the S4 spore zone of England and Wales, and spore zone IIB of the Saar. Nine new species are described for *Punctatisporites: Trilites*, *Acanthotriletes*, *Neoraistrickia*, *Mooreisporites*, *Cristatisporites*, *Radiizonates*, *Columnisporites*, and *Potonieisporites*, and two new combinations are proposed for *Gravisporites* and *Cordaitina*. — Author's abstract

01199 **Haas, Otto.** Recent literature on Mesozoic ammonites, Pt. 12: Jour. Paleontology, v. 45, no. 3, p. 542-552, 1971.

Fifty papers are reviewed briefly, in the format of an annotated bibliography divided into General, Triassic, Jurassic, and Cretaceous sections. — RCD

08521 **Habib, Daniel; Thurber, David; Ross, David; Donahue, Jack.** Holocene palynology of the Middle America Trench near Tehuantepec, Mexico *in* Geological Investigations of the North Pacific (James D. Hays, editor): Geol. Soc. America Mem. 126, p. 233-261, illus., tables, 1970.

Pollen profiles of two cores on the seaward flank of the Middle America Trench are used to interpret the Holocene climatic history of southwestern Mexico. Four pollen zones are distinguished by C-14 dates to 8000-9000 yrs B.P. Pollen and spores per gram of sediment, and the abundance of certain pollen types and altered specimens, are interpreted to reflect variations in moisture and temperature during the Holocene in cordilleran Mexico. Source vegetation and transportation to the sea by streams and winds are considered to be the principal factors in emplacing the pollen zones. The oldest zone (Zone IV) represents a climatic phase which varied from cool-dry to cool-moist. Zone III reflects the period of maximum warmth and moisture. The next higher zone reflects the driest climatic phase. The uppermost zone (Zone I) marks the return to moist conditions. — *from* Authors' abstract

08581 **Haggett, Peter; Chorley, Richard J.** Network analysis is geography: New York, St. Martin's Press, 348 p., illus., tables, 1970.

This book "explores ways in which analysis of a topologically distinct class of spatial structures — linear networks — might throw light on common geographic problems of morphometry, origin, growth, balance and design." It builds on an earlier volume by one author (Locational analysis in human geography) but widens the area of spatial analysis to include physical networks. It is argued that there are equivalent spatial structures common to both geomorphology (stream systems, for example) and human geography (railroad networks) and that common mathematical models can be used for both kinds. The text is in three parts: Spatial structures — topologic and geometric structures; evaluation of structures — structure and flow and location of networks; and structural change — growth and transformation. — VSN

Haller, W. A. *See* Shah, K. R. 08588

01334 **Halls, H. C.; West, G. F.** A seismic refraction survey in Lake Superior [with French abs.]: Canadian Jour. Earth Sci., v. 8, no. 6, p. 610-630, illus., table, 1971.

Thirty-three seismic refraction profiles, obtained in Lake Superior using a single ship sonoboy method, have led to the following conclusions concerning structure and stratigraphy of the late Precambrian Keweenawan basin under the lake: Faults with north side downthrown at least 1-2 km, bound north shores of Isle Royale and Michipicoten Island; the northern limb of the Keweenawan basin just southeast of Isle Royale appears to have undergone deformation partly related to movement along Isle Royale fault; for profiles with some geologic control, refraction velocities agree well with those estimated from sample measurements in the laboratory; and Late Keweenawan or Early Cambrian Bayfield-Jacobsville sandstones underlie most of Lake Superior — their distribution and relative susceptibility to erosion compared with older rocks are the factors that have determined the shape of the lake depression. — *from* Authors' abstract

01183 **Hamilton, Edwin L.** Prediction of in-situ acoustic and elastic properties of marine sediments: Geophysics, v. 36, no. 2, p. 266-284, illus., tables, 1971.

This report is concerned with correction of laboratory values of acoustic and elastic properties of marine sediments to in-place values, and prediction of in-place values in absence of any sediment data. Sediments were assigned to three general environments associated with three great physiographic provinces. Sediment types and properties can be predicted for abyssal plains and abyssal hills provinces, but detailed sediment charts are required for continental shelf areas. Laboratory velocities can be corrected to in-place conditions by multiplying the bottom-water velocity by the velocity ratio (sediment/water). With a correction of 0.05 to 1.0 percent for evaporated salts in pores, porosity can be considered the same as in the laboratory. Density in place is only 0.025 g per cu cm greater at 6,000 m and usually can be disregarded. Using measured values of density and corrected longitudinal wave velocities, plus a computed bulk modulus, other elastic constants can be calculated. Numerical examples are given. — DBV

01230 **Hammond, Allen L.** Plate tectonics — The geophysics of the Earth's surface: Science, v. 173, no. 3991, p. 40-41, 1971.

The agreement between theory and two independent lines of evidence (magnetic anomalies and location of earthquake epicenters along ridge fracture zones and deep earthquakes along ocean trenches) is to many earth scientists convincing proof of the plate tectonic concept at least in its broad outline. Some progress has been made in the understanding of how plates evolve. Uncertainty concerning the driving mechanism reflects present ignorance about the mantle. It is hard to do more than show that a given model of the driving mechanism is consistent with observations; predictions are hard to check. Three proposed mechanisms are outlined briefly. — DBV

08485 **Hand, John W.** Planning for disposal of oil shale, chemical and mine wastes, *in* Governor's Conf. on Environmental Geology: Colorado Geol. Survey Spec. Pub., no. 1, p. 33-37 [1970?].

Total planning for disposal of wastes from the extractive and chemical processing industries is probably not feasible today and may not even be desirable. However, planning for a single industry or interrelated group of industries should be practical. The developing oil shale industry is a case in point. The problems involved in that connection are described. The companies involved are conscious of the needs for preventing pollution and are investigating the most economic means for disposing and controlling wastes. Planning should start with a realistic determination of the needs of the particular environment which will be affected. If reasonable standards are set for the oil shale industry, it will develop and prosper at this time when the resource is needed. — DBV

Handley, H. M. *See* Henderson, A. R. 01065

08468 **Hansen, Edward E.** Sediment movement in a pool and riffle stream [with French abs.], *in* Symposium on the results of research on representative and experimental basins: Internat. Assoc. Sci. Hydrology-Unesco Pub. 96, p. 541-561, illus., tables, 1970.

A sediment budget was constructed for such a stream along which eroding banks were the dominant sediment source. Total sediment load was measured with a DH-48 sediment sampler at artificial sills on the streambed. Supplementary data and an independent check with a long-term reservoir fill rate indicated that the samples were accurate measures. The total load data were used to determine impact of eroding bank sediments on sediment load and streambed composition. Total load increased 530 percent along a 26-mile section of main channel; mostly from eroding banks. Particle-size distribution of the predominantly sand-size sediment load remained the same along the section. The proportion of streambed in sand decreased downstream, while that in cobble and boulder increased, an apparent result of increased gradient. Although sediment load was related to stream discharge, it was believed to be dependent on sediment delivery rate. — *from* Author's abstract

01004 **Hansen, Wallace.** Geologic map of the Black Canyon of the Gunnison River and vicinity, western Colorado: U.S. Geol. Survey Misc. Geol. Inv. Map I-584, 2 sheets, scale 1:31,680, sections, 1971.

Hanshaw, B. B. *See* Pearson, F. J., Jr. 08478

Hanshaw, Bruce B. *See* Leopold, Luna B. 01372

01323 **Hanson, G. N.; Malhotra, R.** K-Ar ages of mafic dikes and evidence for low-grade metamorphism in northeastern Minnesota: Geol. Soc. America Bull., v. 82, no. 4, p. 1107-1113, illus., 1971.

K-Ar mineral and whole-rock ages for mafic dikes and one sill that intrude the early and middle Precambrian rocks of northeastern Minnesota and adjacent areas in Ontario suggest times of intrusion at more than 2200, 1300, and 900 to 1100 m.y. ago. Samples which give K-Ar ages greater than 1300 m.y. show extensive alteration characteristic of low-grade metamorphism (prehnite-pumpellyite facies). For these samples, the whole-rock K-Ar ages have been lowered and suggest that the metamorphism occurred at about 1600 m.y. ago. The samples which give whole-rock K-Ar ages of 1300 m.y. or younger do not show the same type or extent of alteration, nor do the whole-rock K-Ar ages appear to have been appreciably lowered. — Authors' abstract

01083 **Hanson, Merle E.; Sanford, Allan R.; Shaffer, Ronald J.** A source function for a dynamic bilateral brittle shear fracture: Jour. Geophys. Research, v. 76, no. 14, p. 3375-3383, illus., 1971.

A two-dimensional brittle bilateral shear crack was numerically simulated to form and stop in an elastic isotropic medium. The crack surface remained a straight line but underwent rotation that was attributed partially to the starting of the crack and partially to the stopping of the crack. If the crack did not stop, the magnitude of rotation would be about half of the value obtained for this study. The largest displacement was parallel to the fracture and near the line of nucleation. The largest displacement perpendicular to the fracture occurred near the crack tips. Symmetric points across the fracture surface were found to have asymmetric displacements. The percentage of difference among the displacements was largest beyond the crack tips, but the magnitude of the displacement difference was larger near the crack tips. The results of the study are displayed graphically. — Authors' abstract

08597 **Hargis, David R.; Peterson, Frank L.** Artificial recharge practices in Hawaii: Hawaii Univ. Water Resources Research Center Tech. Rept. 43, 36 p., illus., tables, 1970.

The most significant source of artificial recharge to ground-water bodies in Hawaii is probably recharge incidental to irrigation. Seepage from cesspools is also significant. Deliberate artificial recharge to ground-water bodies consists of wells recharging

stream water at Hanapepe, Kauai and Puukapu, wells and pits which dispose of storm drainage at Wailuku and Kahului, Maui, and Hilo, and excess irrigation by induced leakage from ditches and reservoirs and water spreading over fields and in gulches at Hawaiian Commercial and Sugar Company on the East Maui isthmus. The Department of Land and Natural Resources of the State of Hawaii will begin disposal of treated sewage through three deep wells at Waimanalo, Oahu, as soon as sewerage is completed. — *from* Authors' abstract

08457 **Hargraves, R. B.; Buddington, A. F.** Analogy between anorthosite series on the Earth and Moon: Icarus, v. 13, no. 3, p. 371-382, tables, 1970.

Speculation by others as to the origin of the Apollo basalts has primarily involved their production by some degree of partial fusion of the lunar interior, with or without subsequent differentiation. Prior crystallization and separation of considerable plagioclase has been invoked to explain the conspicuous negative Eu anomaly. This interpretation is compatible with the concept of an anorthositic (= plagioclase-rich) lunar crust, inferred from the presence of anorthosite fragments found in the lunar soil and breccia, and deemed to have come from the highlands. In our view, consideration of the diversity and composition of these lunar rocks (making allowance for their low alkali content) and in particular, the evidence of their crystallization from homogeneous liquids, suggests that the massif type of anorthosite series, rather than the stratiform type, may be the closest terrestrial analogs. — Authors' abstract

01061 **Harris, B. B., Jr.** Neutron diffraction study of clay minerals [abs.]: Georgia Acad. Sci. Bull., v. 29, no. 2, p. 125, 1971.

01244 **Harris, C. Earl, Jr.** Origin of salt domes: Earth Sci., v. 24, no. 2, p. 72-75, illus., 1971.

Principal theories of salt dome genesis are divided by time periods into: casual unrelated theories (1860-1901); deposition from solution (1901-1918); and structural or salt-flow theories (1916-24). Most of the early ideas came from study of Five Islands of Louisiana; tectonic theories originated in Germany and Rumania. The two principal ideas that evolved from the salt flow theory were that tangential or lateral pressure or downward thrust of overburden upon the salt bed can be motivating forces. Barton's isostatic downbuilding theory and Nettleton's fluid mechanical concept developed from these. The latter is the theory accepted by most American geologists today. The final form of the dome depends on four factors: the configuration which localized the dome, thickness of mother salt bed, strength of overlying strata, and strength of salt. — ESL

Harris, R. F. *See* Shukla, S. S. 01276

Harris, R. F. *See* Williams, J. D. H. 01277

Hartshorn, J. H. *See* Oldale, R. N. 01023

01022 **Harwood, David S.; Goldsmith, Richard.** Bedrock geologic map of the Oneco quadrangle, Connecticut-Rhode Island: U.S. Geol. Survey Geol. Quad. Map GQ-930, scale 1:24,000, sections, text, 1971.

Haskin, L. A. *See* Denechaud, E. B. 08697

01102 **Hattin, Donald E.** Widespread, synchronously deposited, burrow-mottled limestone beds in Greenhorn Limestone (Upper Cretaceous) of Kansas and southeastern Colorado: Am. Assoc. Petroleum Geologists Bull., v. 55, no. 3, p. 412-431, illus., tables, 1971.

In central Kansas the Hartland Shale and Jetmore Chalk Members of the Greenhorn Limestone contain 16 ledge-forming limestone beds that can be traced across the entire outcrop. The same beds are recognized in the Bridge Creek Limestone Member of westernmost Kansas, and most can be recognized in the Bridge Creek of southeast-

ern Colorado. For nearly 450 miles these beds lie near equally persistent bentonite seams. The parallelism of the bentonite seams and limestone beds, and the uniform spacing of the limestone beds suggest that each of these beds is time parallel. The limestone lacks internal stratification because of faunal activity, in contrast to the intervening beds of laminated shaly chalk. The limestone originated when the volume of terrigenous detrital influx decreased and the accumulation of carbonate sediments continued. — EAM

08567 **Hawaii Div. Water and Land Devel.** Hydrologic data networks — Island of Molokai, rainfall stations, stream-gage stations, ground water: Honolulu, Hawaii Div. Water and Land Devel. Circ. C59, 29 p., illus., tables, 1970.

The circular presents indices of all hydrologic data sources on the island of Molokai, Hawaii. An alphabetical list of rainfall stations is included. The report brings up to date information presented in "Basic water resources data — Molokai," published in 1961. — EH

Hawkins, James W., Jr. *See* Whetten, John T. 08455

01270 **Hawkins, R. H.; Overman, R. F.; Corey, J. C.** Tl-208 and Na-24 gamma sources for identifying soil water tagged with deuterium: Soil Sci. Soc. America Proc., v. 35, no. 2, p. 199-201, illus., 1971.

Tl-208 in secular equilibrium with its parent nuclide Th-228 is superior to Na-24 as a gamma source for tracing downward movement of heavy water (D_2O) in field studies because of the longer half-life of Tl-208. — Soil brief

08451 **Hayes, Dennis E.; Pitman, Walter C., 3d.** Magnetic lineations in the North Pacific *in* Geological Investigations of the North Pacific (James D. Hays, editor): Geol. Soc. America Mem. 126, p. 291-314, illus., 1970.

The work on magnetic lineations in the northeast Pacific has been re-examined and a new lineation map of the area is presented. These lineations are presumed to have been generated by sea-floor spreading. By adopting a time scale, a map is presented of inferred ages of basement rocks and a maximum age for overlying sediments. It has been postulated that tectonic evolution of the northeast Pacific was largely dominated by a "Y"-shaped system of migrating ridge axes which, along with associated trenches, were characterized by periods of activity and inactivity. The barrier nature of these features should have had considerable influence on distribution of terrigenous sediments. A new group of magnetic lineations has been discovered which trends NW and is partially bounded by the Shatsky Rise, Emperior Seamounts and Hawaiian Arch. Quiet magnetic zones separate major lineation areas, giving rise to four zones with distinctive magnetic signatures. These zones may relate to similar magnetic zones in the North Pacific. — *from* Authors' abstract

08449 **Hays, James D.** Stratigraphy and evolutionary trends of Radiolaria in North Pacific deep-sea sediments *in* Geological Investigations of the North Pacific (James D. Hays, editor): Geol. Soc. America Mem. 126, p. 185-218, illus., tables, 1970.

The abrupt, widespread, and simultaneous extinction of radiolarian species makes them ideal stratigraphic markers. Five species became extinct in the North Pacific during the last 3 m.y. Four of these are used to define 4 zones. The boundary between the oldest 2 zones correlates with the Pliocene/Pleistocene boundary, defined in Italy. These zones can be related through paleomagnetic stratigraphy to previously established radiolarian and foraminiferal zonations. One species (*Eucyrtidium matuyamai*) evolved and became extinct during the last 2.5 m.y. Its evolution can be related to invasion and adaptation to a new habitat; its extinction shows a correlation with the magnetic reversal at the base of the Jaramillo event. The environmental change that caused extinction is unclear; there is suggestive evidence that it is in some way related to a reversal of the Earth's field. Reversals may have played an important selective role through geologic time. — *from* Author's abstract

08450 **Hays, James D.; Ninkovich, Dragoslav.** North Pacific deep-sea ash chronology and age of present Aleutian underthrusting *in* Geological Investigations of the North Pacific (James D. Hays, editor): Geol. Soc. America Mem. 126, p. 263-290, illus., tables, 1970.

The 1000-km wide belt of volcanic ash in the North Pacific deep-sea sediments can be divided into two areas based on chronology and composition. The first is in the Northwest Pacific with Japan, Kamchitka, and the Kurils as probable source. The second is south of the active part of the Aleutian Islands from which it was probably derived. In the NW area sedimentation rates are high, exceeding 5 cm/1000 yr. The oldest ash in this area is 1.3 m.y. old. Ashes in cores south of the Aleutians indicate that at least 20 andesitic eruptions have occurred since 1.8 m.y. B. P. Sediments between 1.8 and 2.8 m.y. contain no ashes, suggesting that 1.8 m.y. was the beginning of the present cycle. Andesite volcanism in island arcs is related to depth of underthrusting. By using measured rates and directions of sea-floor spreading it is possible to calculate that the underthrusting must have begun 10 to 14 m.y. B.P. to reach a depth of 100 to 200 km, the depth of andesitic magma formation, by 1.8 m.y. B.P. This could be explained either by a pause in sea-floor spreading prior to this or change in direction of ridge axis causing reorientation of the stress system of the Pacific margin. — *from* Authors' abstract

08526 **Hays, James D.** (editor). Geologic investigations of the North Pacific: Geol. Soc. America Mem. 126, 323 p., illus., tables, 1970.

In this volume, dedicated to Maurice Ewing, 11 articles are given by 16 geologists, all on various aspects of the sea bottom in this area. The first three deal with bottom sediment, bottom water, and near-bottom suspended sediment; 7 papers deal with paleomagnetic stratigraphies, rates and thickness of sedimentation, paleoclimatic cycles, and volcanic activities; the final paper presents new geomagnetic data and ages of basement rocks. Nine papers are cited separately. — EHS

01082 **Healy, J. H.; King, Chi-Yu; O'Neill, M. E.** Source parameters of the Salmon and Sterling nuclear explosions from seismic measurements: Jour. Geophys. Research, v. 76, no. 14, p. 3344-3355, illus., tables, 1971.

The source parameters for the Salmon and Sterling nuclear explosions can be approximated by an equivalent source involving a step function of pressure inside an elastic spherical cavity. The parameters of this theoretical model were determined for Salmon and Sterling by fitting the spectral ratios of the seismic signals. The elastic radius for Salmon is 169 meters; that for Sterling is 29 meters. The ratio of pressures at these radii is about 4. The values of the parameters determined from seismic data are in good agreement with the values determined from gages in the salt dome near the source. The success of this technique suggests that source parameters for small earthquakes might be determined from their spectral ratios. Estimates of the decoupling factor based on this model are in close agreement with values reported in the literature. — Authors' abstract

01135 **Healy, J. H.; Pakiser, L. C.** Man-made earthquakes and earthquake prediction, *in* Seismology, U.S. National Report, 1967-1971, Fifteenth General Assembly, IUGG: EOS, v. 52, no. 5, p. IUGG 171-174, 1971.

Convincing evidence that man can trigger earthquakes has been developed since the last report, increasing understanding of earthquake mechanisms and reinforcing hopes for earthquake prediction. Fluid injection into a deep well triggered earthquakes in the Denver, Colorado, vicinity, and man-made earthquakes are associated with large reservoirs; both these phenomena may be explained by the Hubbert-Rubey mechanism (1959). Earthquakes are also triggered by underground nuclear explosions. Small earthquakes can be used to map active faults and the depth to which stick-slip motion extends. Studies on the San Andreas fault show that fault creep accounts for relative motion of lithospheric plates at depths greater than 10-15 km and that earthquakes are secondary effects in the upper crust where the plates "lock up" for a time. Experiments are being conducted on the relation of fluid pressure to rock failure and strength. — DBV

Heath, G. Ross. *See* VanAndel, Tjeerd H. 01340

08590 **Hedberg, Hollis D.** (editor). Preliminary report on lithostratigraphic units — Internat. Subcomm. Stratig. Classification, Rept. 3: Ottawa, Ontario, Internat. Geol. Cong., 30 p., 1970.

The 12 articles given cover: nature of lithostratigraphic units; the formation, member, bed, and group; boundaries, and naming of lithostratigraphic units; the geographic component of an established lithostratigraphic name should not be changed; procedure in establishing formal lithostratigraphic units; rule of priority; revision of lithostratigraphic classification and nomenclature, and abandoned names. Votes of members on the publication are tabulated, and dissenting comments or qualifying remarks by members are included. — ESL

08591 **Hedberg, Hollis D.** (editor). Preliminary report on stratotypes — Internat. Subcomm. Stratig. Classification, Rept. 4: Ottawa, Ontario, Internat. Geol. Cong., 39 p., illus., 1970.

The nine articles submitted cover: definitions; role in definition of stratigraphic units; general requirements; stratotypes of lithostratigraphic, biostratigraphic, and chronostratigraphic units; application of stratotype concept to a standard global chronostratigraphic scale; and selection of boundary-stratotypes for units in such a scale. Votes for publication are tabulated, and the dissenting comments or qualifying remarks included. — ESL

01255 **Hedberg, Hollis Dow.** Petroleum and progress in geology: Geol. Soc. [London] Jour., v. 127, pt. 1, p. 3-16, 1971.

The influence of the search for petroleum on the development of the science of geology is reviewed in this paper which was given on April 8, 1970, as the 24th William Smith Lecture. — VSN

Heezen, Bruce C. *See* Fox, Paul J. 08600

01319 **Heiken, Grant; Lofgren, Gary.** Terrestrial glass spheres: Geol. Soc. America Bull., v. 82, no. 4, p. 1045-1050, illus., 1971.

Terrestrial glass spheres similar to the glass spheres found in the lunar soil samples have been produced by the eruption of low-viscosity basaltic magmas and by a TNT surface explosion on alluvium. The volcanic spheres range in diameter from 2 μ to several millimeters and have smooth surfaces. The explosion-produced spheres are of similar size but have surfaces covered with smaller spheres and angular particles. Both the volcanic and the explosion-produced spheres have analogs in the lunar materials. — Author's abstract

Heinrichs, Donald F. *See* VanAndel, Tjeerd H. 01340

01145 **Heirtzler, J. R.; Vogt, P. R.** Marine magnetic anomalies and their bearing on polar wandering and continental drift, *in* Geomagnetism and paleomagnetism, U.S. National Report, 1967-1971, Fifteenth General Assembly, IUGG: EOS, v. 52, no. 5, p. IUGG 220-224, 1971.

Marine magnetic anomalies contribute in several ways to the story of plate movements and polar wandering. Reversal anomalies and their spacing, offsets of anomalies along transform faults, and linear anomalies or trends indicate relative motions between plates; anomalies due to remanent magnetization indicate movement relative to the geomagnetic pole and are the only direct clue to polar wandering. These methods, primarily the first two in conjunction with topographic and earthquake data, have been productively applied to the oceanic portions of crustal plates. Synoptic motions of the plates are the basis of much recent research and have provided geologic models now being tested on land. Continental drift has been verified and its details illuminated. Works published during 1967-71 are summarized, with bibliography. — DBV

Hekinian, R. *See* Taylor, P. T. 01034

Helm, Gay. *See* Tolbert, Al. 01262

01077 **Helmberger, Donald; Wiggins, Ralph A.** Upper mantle structure of midwestern United States: Jour. Geophys. Research, v. 76, no. 14, p. 3229-3245, illus., table, 1971.

Body-wave observations from nuclear events at the Nevada Test Site and several earthquakes near the western edge of the United States have been used to construct a model of the upper mantle along profiles extending toward the Great Lakes. The Cagniard-de Hoop technique for computing synthetic seismograms for laterally homogeneous earth models was used to fit both the amplitudes and traveltimes of the observations. The model obtained exhibits a prominent low-velocity zone, sharp discontinuities of velocity at about 430 and 660 km, and a discontinuity in the slope of the velocity at about 550 km. — Authors' abstract

Helmke, P. A. *See* Denechaud, E. B. 08697

01065 **Henderson, A. R.; Handley, H. M.** Factors relating to success of students in physical geology in higher education [abs.]: Georgia Acad. Sci. Bull., v. 29, no. 2, p. 161, 1971.

Henderson, J. B. *See* McGlynn, J. C. 08628

01358 **Henderson, William; Reed, Walter E.; Steel, Gordon; Calvin, Melvin.** Isolation and identification of sterols from a Pleistocene sediment: Nature, v. 231, no. 5301, p. 308-310, illus., table, 1971.

This paper reports some organic geochemical studies of a Pleistocene basin and its contemporary lake (Mono Lake, California) where an attempt is being made to correlate alkane, fatty acid, sterpid, amino-acid, and sugar distribution patterns with stratigraphy and biological environment. The types of sterol found in the sediment examined strongly suggest that they had an algal origin and underwent some reduction during sedimentation and the initial stage of lithification. It may not be possible to use sterol distribution patterns for identification of deposition environment of a sediment. There is evidence of at least partial reduction of naturally occurring molecules within the 130,000 years since deposition. Simulated diagenesis experiments seem to generate significant quantities of the fully reduced steranes. — DBV

Hennessey, W. J. *See* Wright-Broughton, C. 08677

01143 **Hermance, John F.** Magnetotellurics and geomagnetic deep sounding, *in* Geomagnetism and paleomagnetism, U.S. National Report, 1967-1971, Fifteenth General Assembly, IUGG: EOS, v. 52, no. 5, p. IUGG 213-216, 1971.

This is a review and bibliography on regional (U.S. and Iceland) magnetotelluric and geomagnetic anomalies, data analysis, and instrumentation. — DBV

01333 **Herzer, R. H.** Bowie Seamount, a recently active, flat-topped seamount in the northeast Pacific Ocean: Canadian Jour. Earth Sci., v. 8, no. 6, p. 676-687, illus., tables, 1971.

Bowie Seamount, off the west coast of Canada at 53°18′ N., 135°39′ W., is a northeast-trending, volcanic mountain comprising a series of intersecting ridges which may have grown from extrusions along intersecting fractures. Two terraces, forming the flattened summit at depth of 80 and 235 m, are thought to be remnants of platforms produced by shallow-water volcanism and wave erosion during Pleistocene and Recent times when sea level was lower. The last episode of volcanic activity on the summit occurred after formation of the upper terrace, which is probably no more than 18,000 yr old. Samples from the upper half of the volcano include pillow and non-pillowed fragments, pillow breccias, bombs, tuffs, ash, and unsorted tephra. Rocks are mainly alkali olivine basalts with a few intermediate rocks derived by differentiation of basaltic magma. — *from* Author's abstract

Hess, John M. *See* Broding, Robert A. 01052

01121 **Hewitt, David A.; Wones, David R.** Experimental metamorphic petrology, *in* Volcanology, Geochemistry and Petrology, U.S. National Report, 1967-1971, Fifteenth General Assembly, IUGG: EOS, v. 52, no. 5, p. IUGG 73-82, 1971.

Experimental studies in the United States that are applicable to metamorphic petrology range from rigorous formulation of P-T diagrams to thermochemical studies and solubility measurements. This is a summary and bibliography of works on CO_2-H_2O mixtures, oxidation-reduction reactions, fluorine, aqueous solutions, dehydration reactions, layer silicates, chain silicates, tectosilicates, aluminum silicates, carbonates, isotopes and trace elements, and thermochemical data. — DBV

08606 **Hewitt, William Paxton.** San Carlos lead deposit, northeast Chihuahua, Mexico, *in* AIME world symposium on mining and metallurgy of lead and zinc, St. Louis, Missouri, 1970 [Proc.] — V. 1, Mining and concentrating of lead and zinc: New York, Am. Inst. Mining, Metallurgical, and Petroleum Engineers, p. 130-138, illus., 1970.

All mineralized outcrops in the San Carlos deposit occur in a calcareous shaly horizon immediately above the contact between a thick limestone series and underlying quartzites. The mineralization replaced argillaceous dolomitic sediments. These sediments may have been a shoreward facies of Aptian evaporites which occur to the northwest; the quartzites may also be Aptian. There is structural control as well, for the deposit lies along the crest of an anticline. The magnetite silicate matrix was introduced under contact metamorphic conditions; pyrite, sphalerite, and a fine-grained mixture of magnesian minerals were introduced at a lower temperature into brecciated zones in the magnetite complex, and these in turn were fractured and rehealed with galena and associated dolomite or magnesite. High-grade lead ore is associated with tight isoclinal folds near the top of the deposit. — DBV

01180 **Hietanen, Anna.** Distribution of elements in biotite-hornblende pairs and in an orthopyroxene-clinopyroxene pair from zoned plutons, northern Sierra Nevada, California: Contr. Mineralogy and Petrology, v. 30, no. 2, p. 161-176, illus., tables, 1971.

Distribution of Mg/Fe between coexisting biotite and hornblende stays nearly constant through the crystallization differentiation sequence within these zoned plutons, which range in composition from mafic quartz diorite at borders to monzotonalite at centers. Change in Fe and Mg content of magma during crystallization is reflected in decrease of percentage of hornblende toward centers, which crystallized last. In contrast, percentage of biotite stays at the same level or shows local variations. Thus, biotite/hornblende ratios increase in general toward centers, but partitioning of Mg and Fe between these minerals stays uniform. The notable difference in distribution coefficient for biotite-hornblende pairs in tonalite of southern California batholith (0.83) and for these pairs in the Feather River area (0.65) is likely due to different PT conditions during crystallization. — *from* Author's conclusions

01080 **Hill, David P.** Velocity gradients and anelasticity from crustal body wave amplitudes: Jour. Geophys. Research, v. 76, no. 14, p. 3309-3325, illus., table, 1971.

The amplitude spectra of critically refracted waves are sensitive to small velocity gradients in the refracting horizon. Negative gradients and anelasticity (Q^{-1}) result in similar amplitude decays with distance for narrow bandwidth data; positive gradients result in a net amplitude gain with distance with respect to the zero gradient, infinite Q case. Application of these results to published Pg and P. amplitude data indicates that negative velocity gradients of the order of 10^{-3} km sec^{-1} km^{-1} may be present in the crystalline crust and intermediate layer in the high heat flow Basin and Range province, and that positive velocity gradients are present in corresponding horizons in the provinces having normal heat flow in the eastern United States and west coast. Velocity gradients inferred from laboratory measurements of velocity variations in granites and basic igneous rocks with temperature and pressure, together with published geothermal gradients for the Basin and Range province and the eastern United States, are consistent with this result. — Author's abstract

08482 **Hilpman, Paul L.** Urban growth and environmental geology, *in* Governor's Conf. on Environmental Geology: Colorado Geol. Survey Spec. Pub., no. 1, p. 16-19, tables [1970?].

Essential urban activities that are of vital concern to the environmental geologist are waste disposal, transportation, flood control, water supply, design and construction of foundations, extraction of mineral resources, open-space and recreation, underground utility networks, and land reclamation and urban renewal. Geologic data are seldom used by urban planners because they are not presented in a style and language intelligible to non-geologists. Maps showing the areal distribution of quantitative differences measured for each of the most important physical factors involved offer a useful means of presenting selected information applicable to a given land use. The planner can use this information to generate suitability maps upon which planning decisions are ultimately based. Environmental geology is not a subfield of geology, but a perspective which recognizes the high relevance between geology and contemporary society. — DBV

01007 **Hinrichs, E. N.; Connor, J. J.; Moore, H. J., 2d; Krummel, W. J., Jr.** Geologic map of the southeast quarter of the Hatch Point quadrangle, San Juan County, Utah: U.S. Geol. Survey Misc. Geol. Inv. Map I-669, scale 1:24,000, 1971.

01008 **Hinrichs, E. N.; Krummel, W. J., Jr.; Connor, J. J.; Moore, H. J., 2d.** Geologic map of the southwest quarter of the Hatch Point quadrangle, San Juan County, Utah: U.S. Geol. Survey Misc. Geol. Inv. Map I-670, scale 1:24,000, section, 1971.

Hitchen, A. *See* Beals, C. S. 08459

01243 **Hlavin, William J.** Ohio's Permian formations: Earth Sci., v. 24, no. 2, p. 69-71, illus., 1971.

Highway excavations in Washington County have led to the discovery of a new source of fossil vertebrates, in the Dunkard Series, which is divided into two stratigraphic units, the Washington Formation, and the higher Greene Formation. The age of the Dunkard Series had been a point of disagreement due to lack of diagnostic fossils. In the 1930's the first major vertebrate fossil-producing area was discovered at Cameron, Ohio. This material led to correlation of the Dunkard with Permian Wichita red beds in Texas and Oklahoma. In 1965, highway excavation near Marietta, Ohio, uncovered an ancient stream channel incised in soft red shale; from the vertebrate fossils here, more than 15 genera probably will be identified. The most abundant are fresh-water sharks, amphibians are represented by several forms, and the most dominant reptile is a pelycosaur. A more terrestrial environment is indicated. — ESL

Hoagland, Alan D. *See* Fischer, Frederick T. 08603

01006 **Hoare, J. M.; Condon, W. H.** Geologic map of the Marshall quadrangle, western Alaska: U.S. Geol. Survey Misc. Geol. Inv. Map I-668, scale 1:250,000, separate text, 1971.

Hoffer, Jerry M. *See* Lovejoy, Earl M. P. 01324

08531 **Hoffer, Jerry M.** Plagioclase mineralogy of the Rock Creek flow, Columbia River basalt, *in* Columbia River Basalt Symposium, 2nd, Cheney, Wash., 1969, Proc.: Cheney, Eastern Washington State College Press, p. 51-53, 1970.

The thick (250-470 feet) porphyritic Rock Creek flow was selected for study of the relationships between chemical composition and structural state of groundmass and phenocryst plagioclase. The composition of groundmass plagioclase is related to its size and to the amount of associated glass in such a way as to suggest that the slower the cooling, the more sodic the groundmass plagioclase crystals. Groundmass plagioclase crystals less calcic than An_{50} predominantly have a higher structural state than the enclosed phenocrysts, whereas the reverse is true for groundmass plagioclase more calcic than An_{50}. — DBV

08632 **Hoffman, P. F.; Fraser, J. A.; McGlynn, J. C.** The Coronation geosyncline of Aphebian age, District of Mackenzie, *in* Basins and geosynclines of the Canadian Shield (A. J. Baer, editor) — Symposium, Ottawa, 1970, Papers: Canada Geol. Survey Paper 70-40, p. 201-212, illus., 1970.

There are four belts of Aphebian sedimentary and volcanic rocks (Great Slave, Epworth, Goulburn, and Snare) in the MacKenzie district, remnants of an arcuate orthogeosyncline developed 1,750 to 2,000 m.y. ago between a craton to the east and a late Aphebian orogenic belt (Bear Province) to the west. Four phases in the depositional history of this "Coronation geosyncline" are: a pre-orogenic orthoquartzite-carbonate phase; a transitional euxinic-volcanic phase; an early synorogenic flysch phase; and a late synorogenic molasse phase. The Coronation strata are intensely deformed and metamorphosed only in the orogenic belt, but are displaced by many westerly dipping low-angle thrusts adjacent to that belt. The Coronation geosyncline is in general similar to the classic Phanerozoic orthogeosynclines of North America. — DBV

01195 **Hofmann, H. J.** Polygonomorph acritarch from the Gunflint Formation (Precambrian), Ontario: Jour. Paleontology, v. 45, no. 3, p. 522-524, illus., 1971.

An organically preserved microfossil (*Veryhachium*? sp.), representing the oldest known occurrence of the acritarch Subgroup Polygonomorphitae, occurs in black, stromatolitic chert of the basal part of the late Aphebian (1700 m.y. old) Gunflint Formation near Schreiber, Ontario. — Author's abstract

Holowaychuk, N. *See* Miller, F. P. 01280

Holowaychuk, N. *See* Miller, F. P. 01281

08656 **Homme, Frank C.; Rosenzweig, Abraham.** Contact metamorphism in the Tres Hermanas Mountains, Luna County, New Mexico, *in* Guidebook of the Tyrone-Big Hatchet Mountains-Florida Mountains region — New Mexico Geol. Soc. Field Conf., 21st, 1970: Socorro, N. Mex., New Mexico Bur. Mines and Mineral Resources, p. 141-145, illus., 1970.

In these mountains 25 miles south of Deming, Tertiary volcanics overlie or intrusions cut Paleozoic limestone and dolostone. Silver, lead, and gold were mined from small veins, then zinc from northern veins and replacement bodies; more recent is quarrying of banded onyx and similar minerals. Lower Hueco and upper Magdalena beds, cut by a quartz monzonite stock, are separated into several blocks by three apophyses and dike-like extensions of it, and are metamorphosed along contact to hornfels and garnet-banded marble, poorly preserving large gastropods. Three distinct stages of metamorphism, and a final hydrothermal surge producing a complex tactite are described briefly; mineral assemblages are listed. East of one northwest-trending apophysis, a spurrite skarn lens was studied in detail, particularly its twinning. — GDC

01205 **Horai, Ki-iti; Nur, Amos.** Reply [to Comments on a paper by Ki-iti Horai and Amos Nur, "Relationship among terrestrial heat flow, thermal conductivity, and geothermal gradient," 1970]: Jour. Geophys. Research, v. 76, no. 14, p. 3428, 1971.

The paper under discussion was published in Jour. Geophys. Research, v. 75, no. 11, p. 1985-1991, 1970; *see* Abs. North American Geology, November 1970).

Horn, B. M. *See* Horn, D. R. 08445

08445 **Horn, D. R.; Horn, B. M.; Delach, M. N.** Sedimentary provinces of the North Pacific *in* Geological Investigations of the North Pacific (James D. Hays, editor): Geol. Soc. America Mem. 126, p. 1-21, illus., map, 1970.

The 250 long piston cores from the North Pacific belong to distinct regions named sedimentary provinces of which there are three orders. First order provinces follow the general form of the basin and are of great areal extent, limits of which match boundaries of major water masses: Central North Pacific, Japan-Kuril, Aleutian-Alaskan Provinces. The second order are dominated by positive submarine relief and restricted in size, and boundaries follow the configuration of hills and ridges: Hawaiian Ridge, Marcus-Necker Ridge, Shatsky Rise, Emperor Seamount Chain, Ridge and Trough Provinces. The third order constitutes a narrow zone of terrigenous sediment around the rim of the North Pacific basin, and include floors of

circum-Pacific trench system and part of the NE Pacific corner. Two named are the Aleutian Trench and the Northeast Pacific Turbidite Provinces. — *from* Authors' abstract

Horn, Katherine J. *See* Smith, Merritt B. 01086

01170 **Housner, G. W.; Hudson, D. E.** Preliminary report on the engineering aspects of the San Fernando, California, earthquake of February 9, 1971: Seismol. Soc. America Bull., v. 61, no. 2, p. 499-500, 1971.

The intensity of shaking in the epicentral region of the M = 6.6 San Fernando earthquake appears to have been as severe as that of a shock of M = 8. Main energy release was at an unusually shallow depth, which would account for the heavy damage. Associated with overthrust faulting were surface expressions of permanent ground displacements. There also were earth-slides and consolidation or liquifaction of soils. Old, weak buildings in the area of strong and moderately strong shaking suffered considerable damage. Modern buildings designed according to the building code performed as expected, though a few collapsed wholly or in part, and several in the region of strong shaking were severely damaged. Special accelerogram information was provided by the Cal Tech Millikan Library (9 stories, RC shear wall). The record at Pacoima dam, the strongest ever recorded, is indicative of the very special conditions there, and the high-frequency peaks presumably reflect fracturing of the rock. — DBV

01064 **Howard, J. Hatten, 3d.** Geochemistry of selenium — Adsorption from natural waters [abs.]: Georgia Acad. Sci. Bull., v. 29, no. 2, p. 126, 1971.

Howard, Keith A. *See* Wilshire, H. G. 01317

08474 **Howe, Robert H. L.** The development of a new technique for the evaluation of a watershed [with French abs.], *in* Symposium on the results of research on representative and experimental basins: Internat. Assoc. Sci. Hydrology-Unesco Pub. 96, p. 677-680, 1970.

A new method for the evaluation of hydrological conditions of a watershed through studies of the geology, ground formations, soils, vegetation, topography, land forms, land uses, climate, and other pertinent hydrological elements of a watershed by aerial photographic techniques is discussed. The reliability of this method is further verified by ground surveys and physical tests. Studies of the important elements of the watershed result in a comprehensive evaluation of the hydrological conditions of the area. Needed mathematical formulas for the evaluation of the water availability and water quality relationship are explained. — Author's abstract

01271 **Howeler, R. H.; Bouldin, D. R.** The diffusion and consumption of oxygen in submerged soils: Soil Sci. Soc. America Proc., v. 35, no. 2, p. 202-208, illus., tables, 1971.

Oxygen consumption of soil cores taken from lakes was measured. The distribution of iron removed by different extrants was determined as a function of distance from the surface of the core. Oxygen consumption was found to depend upon microbial activity in the oxidized zone and diffusion of reduced Fe^{2+} to the aerobic-anaerobic interface in the cores. — Soil brief

01365 **Huber, N. King.** Pink copper-bearing prehnite from Isle Royale National Park, Michigan: Earth Sci., v. 24, no. 1, p. 9-14, illus., 1971.

Prehnite is an abundant secondary mineral in Keweenawan lava flows of the Lake Superior region. It occurs as amygdules, cross-cutting veins, and replacements. In amygdules, it is pink or pink and green, rather than the normal light green. They range in size from 0.5 to 1 cm, and show a radiating fibrous habit. The color is due to distribution and grain size of native copper inclusions. Prehnite can be distinguished from thomsonite, which it superficially resembles, by specific gravity, hardness, and refractive index. — ESL

Huber, Richie D. *See* Adams, William M. 08595

Hudson, D. E. *See* Housner, G. W. 01170

00996 **Hunt, Graham R.; Salisbury, John W.; Lenhoff, Charles J.** Visible and near-infrared spectra of minerals and rocks — [Pt.] 3, Oxides and hydroxides: Modern Geology, v. 2, no. 3, p. 195-205, illus., 1971.

Visible and near-infrared spectra of various oxide and hydroxide minerals are presented, together with explanations of special features. It is shown that the principal bands are due to electronic processes in the cation of impurity ions, or to vibrational processes in hydroxyl groups or molecular water. Of the cations, iron is the most common source of electronic features, either as the principal constituent or as an impurity. Other features are produced by chromium, copper and titanium ions. — Authors' abstract

08429 **IASH-Unesco.** Symposium on world water balance, V. 1: Internat. Assoc. Sci. Hydrology-Unesco Pub. 92, 241 p., illus., tables [1970?].

In the Symposium, water is looked at from a fundamentally scientific viewpoint, including ice and vapor as well as water. Thirty papers consider forms and distribution, varying abundances, how it becomes available as a natural resource, and the effect which man is having on this. It is hoped that the discussion will show how firm the background of fact and theory is on which far-reaching decisions about water supplies must be made. Three papers are cited separately. — ESL

08475 **IASH-Unesco.** Symposium on the results of research on representative and experimental basins: Internat. Assoc. Sci. Hydrology-Unesco Pub. 96, 737 p., illus., tables, 1970.

This symposium, held in New Zealand in 1970, is divided into five topic sessions: hydrological processes; application of experimental design and statistical techniques; results of research on a basin and on a regional basis; determination of representativeness of selected basins; and general development of new techniques. Of the 55 papers included, 5 are cited separately. — ESL

08572 **IASH-Unesco.** Symposium on the hydrology of deltas, V. 1: Internat. Assoc. Sci. Hydrology-Unesco Pub. 90, p. 1-238, illus., tables, 1970; V. 2, Pub. 91, p. 239-491, illus., tables, 1970.

This symposium on the hydrology of deltas in temperate zones was held in Romania. V. 1 contains 26 papers, of which four are cited separately, and V. 2 has 29, four of which are cited separately. — ESL

08623 **Igarashi, Y.; Ridlon, J. B.; Campbell, J. R.; Allman, R. L.** Note on a mode of piston core disturbance: Jour. Sed. Petrology, v. 40, no. 4, p. 1351-1355, illus., table, 1970.

Inadvertant rupture of a plastic bag of 3 mm diameter lead pellets, part of the equipment used to photograph a piston corer in action, resulted in pellet drag to nearly one meter along the side of the core without significant lithologic drag effects showing up on the X-radiograph of the whole core. This discovery suggests a mode of surficial coarse particle distortion which may be more common than heretofore realized. Consequently, care should be exercised when these types of cores are used for studying the mass physical properties of sea-floor sediments especially when textural and mineralogical parameters are correlated with acoustic properties, and for sound velocity measured normal to the core. — *from* Authors' abstract

08686 **Illiman, W. I.; McLachlan, J.; Edelstein, T.** Marine algae of the Champlain Sea episode near Ottawa: Canadian Jour. Earth Sci., v. 7, no. 6, p. 1583-1585, illus., 1970.

Examination of a marine algal deposit from the Champlain Sea (10,800 ± 150 y old) found by Mott (1968) revealed that it is composed mainly of well preserved blades of *Laminaria*. These were associated with another brown species not susceptible of

definite identification and a single fragment of a foliose red species, probably *Rhodymenia*. Filaments of *Audouinella membranacea* were found in hydroids in the deposit and another small red alga, *Acrochaetium* identified. The presence of several plant pigments was indicated by chromatographic and spectrographic techniques. — Authors' abstract

08560 **Inderbitzen, A. L.** Empirical relationships between mass physical properties for recent marine sediments off southern California: Marine Geology, v. 9, no. 5, p. 311-329, illus., tables, 1970.

Mass physical property data from 137 cores of recent marine sediments were used to examine these properties in marine sediments and the relation between shear strength and sedimentation rate. Clay and water content increases with distance offshore; void-ratio values for sediments increase with increasing clay-size fraction and decrease with increasing shear strength. The void ratio-percent clay relation is related to sedimentation rate; the steeper the slope of the ratio, the faster the rate of sedimentation. The increase of shear strength and decrease of water content with depth in the sediments are linear functions. There appear to be no direct correlations between sedimentation rate and (1) amount of clay-size material in the sediments, (2) rate of shear strength increase with depth, or (3) rate of water content decrease with depth in the sediment. It is concluded that the more rapidly material is deposited, the more water it can contain, and the lower the shear strength will become. — HRC

08476 **International Atomic Energy Agency.** Isotope hydrology, 1970 — Proceedings of symposium on use of isotopes in hydrology, 1970: Vienna, Austria, Internat. Atomic Energy Agency STI-Pub. 255, 918 p., illus., tables, 1970.

The 54 papers in this proceedings over various aspects of the use of isotopes in hydrology, and are grouped under headings which include carbon-14 dating of ground water, environmental isotopes in the water cycle, tracer and environmental isotope techniques, sediment studies, borehole techniques and nuclear instruments, leakage from reservoirs and canals, and others. Two of the papers are cited separately in this volume. — EH

01258 **Irvine, T. N.; Baragar, W. R. A.** A guide to the chemical classification of the common volcanic rocks: Canadian Jour. Earth Sci., v. 8, no. 5, p. 523-548, illus., tables, 1971.

A chemical classification of volcanic rocks is presented, with three main groups: subalkaline, alkaline, and peralkaline. The subalkaline rocks are subdivided into a tholeiitic basalt series and calc-alkali series. The alkaline rocks are subdivided into an alkali olivine basalt series and the nephelinic, leucitic, and analcitic rocks. The steps in classifying the rocks according to this system are outlined. — DBV

01182 **Irwin, J. H.; Stevens, P. R.; Cooley, M. E.** Geology of the Paleozoic rocks, Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah: U.S. Geol. Survey Prof. Paper 521-C, p. C1-C32, illus., table, 1971.

Sedimentary rocks of Paleozoic age, present throughout the 25,000 sq mi of this area in the south-central Colorado Plateau, crop out only in Monument Valley, Defiance Plateau, Zuni Mts., and the southwestern part of the reservations. Cambrian, Devonian, and Mississippian strata have a combined thickness of nearly 1500 feet at the confluence of Colorado and Little Colorado Rivers and 1200 feet in the Four Corners area; they thin eastward and southeastward across the area and are absent in the southeastern part. Major formations are described, and regional relations discussed. Ordovician and Silurian age rocks do not occur in the Navajo country. Pennsylvanian and Permian rocks are described in their principal exposures in southwestern Navajo country, Defiance Plateau, and Monument Valley. Regional relations of all formations are discussed. — VSN

Irwin, William P. *See* Jones, David L. 01386

01134 **Isacks, Bryan.** Seismicity, regional tectonics, and earthquake statistics, *in* Seismology, U.S. National Report, 1967-1971, Fifteenth General Assembly, IUGG: EOS, v. 52, no. 5, p. IUGG 165-170, 1971.

This review and bibliography cover papers on the integration of data on worldwide regional seismicity with the global tectonics concept; on the use of data on precisely located small earthquakes and microearthquakes and microearthquakes to study processes of faulting and volcanism; on the sequence of large earthquakes in time and space and other aspects of long-term seismicity, and the statistical features of the distributions of earthquake with respect to time and magnitudes. — DBV

08438 **Ivems, J. Loreena.** Annotated list of publications, 1895-1970, Illinois State Water Survey: Urbana, Ill., Illinois State Water Survey, 84 p., illus., 1970.

The State Water Survey issues three formal series of publications: Bulletins, Reports of Investigations, and Circulars. A miscellaneous Publications category includes technical letters and other brief materials, as well as brochures. Other Water Survey studies are disseminated through reports prepared for granting or contracting agencies or through reprints from scientific journals and periodicals. In this booklet publications in each series and group are listed and briefly described starting with the most recent issue. — Author's introduction

08480 **Ivey, John B.** Definition of environmental geology and purpose of the conference, *in* Governor's Conf. on Environmental Geology: Colorado Geol. Survey Spec. Pub., no. 1, p. 3-7 [1970?].

The purpose of this conference is to communicate directly with planners. The future of Colorado, its communities, and its economics rests with those who must plan its development. The lessons of the past must be considered so that the natural wealth of the state is used in a manner compatible with social well-being. Wise and coordinated approach to the use of the geologic environment for our good will bear interest payable to the state at rates which its banking laws would consider usurious. — DBV

Jackson, Dallas B. *See* Swanson, Donald A. 01377

Jackson, G. D. *See* Dimroth, E. 08629

Jenne, E. A. *See* Gosling, A. W. 01152

01252 **Jessop, Alan M.; Judge, Alan S.** Five measurements of heat flow in southern Canada [with French abs.]: Canadian Jour. Earth Sci., v. 8, no. 6, p. 711-716, illus., tables, 1971.

Heat flow measurements in boreholes in southern Canada at Oldham (Nova Scotia), Kelly Cross, Ottawa, Winnipeg, and Penticton (British Columbia) indicate values of 1.35, 0.88, 0.80, 0.70, 1.60 μcal/cm^{2}sec or mean temperature gradients of 13.0, 15.8, 14.2, 10.9, and 37.5 C°/km, respectively. These values agree with existing heat flow patterns previously established. — VSN

01030 **Johnson, A. I.** Ground water, *in* U.S. National Report, 1967-1971, Fifteenth General Assembly, IUGG, — Oceanography: EOS, v. 52, no. 6, p. IUGG 265-279, 1971.

Many accomplishments were completed in the field of ground-water hydrology in 1967-70 in data collection and areal investigations as well as in research, special studies, and manpower training. A greater number of quantitative model studies were initiated as a result of the impact of earlier model studies on ground-water use. Specific objectives ranged from review of court decrees in terms of maximizing use of ground water to development of underground storage as an alternative to surface reservoirs. Increased attention is being given to development of methods for regional analysis of ground-water systems. Ground-water research has become increasingly concerned with ground-water planning and management and with the social, economic, and legal aspects of the resource. The mass of data now being collected

has created need for refinement and application of automated data processing. A bibliography of more than 10 1/2 pages is given. — DBV

01264 **Johnson, Ian M.; Smylie, D. E.** An inverse theory for the calculation of the electrical conductivity of the lower mantle: Royal Astron. Soc. Geophys. Jour., v. 22, no. 1, p. 41-53, 1971.

The problem of the recovery of the electrical conductivity profile of the Earth's mantle from its attenuation properties to the main magnetic field generated in the core is shown to have a unique solution. The method of solution is based on the theory of the inverse Sturm-Liouville problem developed by Gel'fand and Levitan. The numerical calculations involved appear to be practical. — Authors' summary

01173 **Johnson, J. G.** A quantitative approach to faunal province analysis: Am. Jour. Sci., v. 270, no. 4, p. 257-280, illus., tables, 1971.

Brachiopod provinces and the areas they occupied have been predetermined by qualitative methods. The strength of endemism and contrasting pervasiveness of cosmopolitanism is expressed by degrees of faunal resemblance which can be measured by a Provinciality Index (PI) consisting of a weighted ratio of common and endemic genera. Values obtained without exception confirm previous conclusions that provinciality between eastern and western North America was strongest in late Early Devonian to Middle Givetian. Breakdown of east-west provinciality coincident with latest Middle Devonian onlap, across the continental backbone, is confirmed by a significant jump in a chronologic series of PI values. Extra-North American PI values confirm a similar picture reflecting strong Early and Middle Devonian provinciality and Frasnian cosmopolitanism of nearly global extent. Land barriers were of prime importance in formation of Devonian provinces. — *from* Author's abstract

01349 **Johnson, J. G.; Westbroek, Peter.** Cardinalia terminology of rhynchonellid brachiopods: Geol. Soc. America Bull., v. 82, no. 6, p. 1699-1701, illus., 1971.

The purpose of morphological terms is communication. To satisfy this requirement, general agreement on the meanings of morphological terms is mandatory. On the question of cardinalia terminology of rhynchonellid brachiopods, we believe that in the case of cardinalia, including both subhorizontal and ascending plates, the use of inner hinge plates and crural plates, respectively, for these two elements is mandatory. We believe that when only a single pair of plates is present in the cardinalia of some brachiopods, confusion can arise, but definitions are best founded on a clear-cut relationship and not on a problematical one. — HCR

01371 **Johnson, Jesse O.** Determination of radium-228 in natural waters: U.S. Geol. Survey Water-Supply Paper 1696-G, 26 p., illus., tables, 1971.

Radium isotopes occur in extremely minute quantities in most natural waters. An EDTA method for determining the beta-active isotope, Ra-228, is described, and extensions of the method for the alpha-emitting radium isotopes are discussed. Some preliminary results are tabulated. Two radioactive-nuclide contamination problems were encountered because yttrium and lanthanum compounds contained considerable amounts of radioactive impurities. A table of calculation factors for Ra-228 determination is included. — ESL

Johnson, Lane R. *See* Bakun, William H. 01389

Johnson, Robert W., Jr. *See* Stearns, Richard G. 08607

01234 **Johnson, W. H.; Glass, H. D.; Gross, D. L.; Moran, S. R.** Glacial drift of the Shelbyville Moraine at Shelbyville, Illinois: Illinois Geol. Survey Circ. 459, 22 p., illus., table, 1971.

The Shelbyville Moraine at the type locality is a terminal moraine consisting of a single Wisconsinan till whose base lies at the same general elevation as the Illinoian drift plain to the south. Robein Silt, Morton Loess, Roxana Silt, and Berry Clay and Van-

dalia Till members of the Glasford Formation (approximately from younger to older) are exposed below the Shelbyville Drift. A radiocarbon date of 21,400 ± 1,000 years B.P. from organic material in the top foot of the Berry Clay indicates that from late Illinoian to early Woodfordian time accretion-gley accumulated locally and loess deposited during this period was incorporated into the Berry Clay. Radiocarbon dates of 21,300 ± 500 and 20,000 ± 200 yr B.P. respectively from the base and top of Robein Silt indicate that at Shelbyville the Robein is Woodfordian in age and contemporaneous with Morton Loess. — *from* Authors' abstract

Johnson, W. Hilton. *See* Leonard, A. Byron. 01361

01015 **Johnson, William D., Jr.** Geologic map of the Rosine quadrangle, western Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-928, scale 1:24,000, section, 1971.

01019 **Johnson, William D., Jr.** Geologic map of the Horton quadrangle, Ohio County, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-915, scale 1:24,000, section, 1971.

Johnston, G. H. *See* Crawford, C. B. 01212

Johnstone, Donald L. *See* Crosby, James W., 3d. 01223

01386 **Jones, David L.; Irwin, William P.** Structural implications of an offset Early Cretaceous shoreline in northern California: Geol. Soc. America Bull., v. 82, no. 4, p. 815-822, illus., 1971.

Recognition of a nonmarine to marine transition in sedimentary rocks at Glade Creek and Big Bar in the southern Klamath Mountains permits reconstruction of the approximate position of a north-trending Early Cretaceous (Valanginian) shoreline. At the southern end of the Klamath Mountains, the shoreline is displaced 60 mi or more to the east by a west-northwest-trending fault zone. South of this fault zone the shoreline is buried at a much lower level beneath late Cenozoic rocks in the Great Valley. This large displacement probably is the result of differential movement along a system of left-lateral tear faults in the upper plate of the Coast Range thrust. The westward bulge of the Klamath arc also may have resulted from this faulting, as the amount and direction of the bulge is comparable with the displacement of the Valanginian shoreline. — *from* Authors' abstract

08663 **Jones, Paul H.** Hydrology of Quaternary delta deposits of the Mississippi River, *in* Symposium on the Hydrology of Deltas, V. 1: Internat. Assoc. Sci. Hydrology-Unesco Pub. 90, p. 49-63, illus., 1970.

These deposits, with interbedded marine sediments, have a cumulative maximum thickness greater than 13,000 feet, of which the delta deposits constitute perhaps half. They underlie a coastal belt some 300 mi in length, and extend more than 150 mi from the coast beneath the Gulf. The late Quaternary deltaic mass contains almost no fresh water although crossed by streams carrying runoff, due to expulsion of saline waters from incompetent prodelta clay beds overridden by advancing deltaic sediments. Distributary channel deposits end gulfward in marine clay and join headwards with those of the trunk stream to form an integrated system on conduits, through which water expelled from compacting sediments is discharged upvalley. This continuing discharge causes landward movement of saline ground water threatening fresh-water supplies, and must be considered in development of fresh-water resources. — *from* Author's abstract

01110 **Jones, R. B.** Folded faults and sequence of thrusting in Alberta Foothills: Am. Assoc. Petroleum Geologists Bull., v. 55, no. 2, p. 292-306, illus., table, 1971.

Thrust faults in the Alberta Foothills were folded by development of step-thrusts and other thrust-generated structures beneath them. By invoking folded faults, several structures in this region can be interpreted with more consistency than with other interpretations. Most relations indicate a west-to-east sequence of thrust emplacement, but some suggest an east-to-west sequence. This apparent contradiction might be

resolved if the time taken for a thrust to form and spread is larger than the time interval between initiation of successive thrusts. — EGS

08550 **Jones, Thomas A.** Comparison of the descriptors of sediment grain-size distributions: Jour. Sed. Petrology, v. 40, no. 4, p. 1204-1215, illus., tables, 1970.

Because both moment and graphical methods [for analyzing weight-frequency data] have defects, an alternative estimation technique is desirable. Fitting a cumulative Edgeworth distribution to the observed cumulative data provides estimates which do not have the undesirable properties. A brief replication study shows the variance of the Edgeworth estimates is generally less than that of the graphical and sample moment estimates. — *from* Author's abstract

Judge, Alan S. *See* Jessop, Alan M. 01252

08505 **Kaesler, Roger L.** Numerical taxonomy in paleontology — Classification, ordination and reconstruction of phylogenies, *in* Computers in paleontology — North Am. Paleont. Convention, Chicago, Ill., 1969, Proc., Pt. B: Lawrence, Kans., Allen Press, p. 84-100, illus., 1970.

This paper presents briefly the aims of numerical taxonomy; discusses some of the systematic problems numerical taxonomists have addressed, and illustrates the applicability of their approaches to paleontology; and reemphasizes a point made previously (1967) regarding the need for active participation of taxonomists in the development of numerical taxonomy. The application of the computer is of interest only insofar as the machine contributes to the solution of problems. — DBV

01376 **Kaplar, Chester W.** Experiments to simplify frost susceptibility testing of soils: U.S. Army Corps Engineers Cold Regions Research and Eng. Lab. Tech. Rept. 223, 23 p., illus., tables, 1971.

Experiments conducted at USA CRREL in recent years indicate that the two weeks or so required for the frost susceptibility testing of soils with previous procedures can be shortened considerably. Results of experiments show that useful frost heaving data can be obtained in a matter of two or three days by a more rapid freezing technique. Results of experiments in which soil specimens were exposed to a constantly maintained temperature are presented. Data show that heave rate in laboratory experiments is a variable of a soil and is strongly dependent on the heat extraction rate. The important role of frost susceptibility testing and soil evaluation for highway design is discussed, also the suitability of equipment for use in conducting frost-heaving tests. — *from* Author's abstract

08691 **Kapp, Ronald O.** Pollen analysis of pre-Wisconsin sediments from the Great Plains, *in* Pleistocene and recent environments of the central Great Plains: Kansas Univ. Dept. Geology Spec. Pub. 3, p. 143-155, illus., 1970.

Results are summarized of pollen analysis of sediments from the Kingsdown Formation in southwestern Kansas and northwestern Oklahoma. The fossiliferous beds are assigned to Illinoian glacial and Sangamon interglacial ages. In Illinoian time, coniferous forests of the Rocky Mountain Front Range and foothills extended to the Southern High Plains; forest trees clearly advanced at the expense of open, treeless prairie. Phytogeographic shifts provided E-W migrational routes for mammals along forest corridors at least across the northern Great Plains. Pollen evidence from the Sangamon interglacial sediments, especially the absence of *Picea*, suggests a warmer summer climate, and abundant nonarboreal pollen in some spectra reflects expansion of prairie vegetation. Prairie vegetation in the central United States thus is not unique to postglacial time. — VSN

01329 **Kaufman, Alvin.** The oceans — Future source of minerals, *in* Council of Economics, Proc., [V. 6] — AIMMPE, Ann. Mtg., New York, 1971 [Papers]: [New York] Am. Inst. Mining, Metallurgical and Petroleum Engineers, p. 67-73, 1971.

The author reviews known ocean mineral resources and their current production and concludes that, aside from petroleum and natural gas, there is no urgent need for the mineral wealth of the ocean, and that unless environmental problems in mining the ocean bottom are solved, public opinion may prevent such offshore activity. — EH

01502

01126 **Kaula, William M.** Global correlations, *in* Tectonophysics, U.S. National Report, 1967-1971, Fifteenth General Assembly, IUGG: EOS, v. 52, no. 5, p. IUGG 119-122, 1971.

This is a summary and bibliography of geophysical data compilation related to tectonics, worldwide statistical analyses of data, attempts at regional classification, and discussions of data correlations that treat all adequately measured examples of at least one class of regions. — DBV

01210 **Kaye, John M.** A peccary from the Pleistocene or Holocene of Mississippi: Tulane Studies Geology and Paleontology, v. 8, no. 4, p. 219-220, illus., 1971.

08674

The finding of fossil peccary bones, partially buried below almost three feet of soil in a road cut on the campus of Mississippi State University, is reported. Only two elements could be found, diagnostic metapodials III and IV, apparently from the same extremity. Because of the lack of comparative material, it has not been determined whether the bones are metatarsals or metacarpals. — DBV

01069 **Keays, Reid R.; R. Ganapathy, R.; Anders, Edward.** Chemical fractionations in meteorites — [Pt.] 4, Abundances of fourteen trace elements in L-chondrites; implications for cosmothermometry: Geochim. et Cosmochim. Acta, v. 35, no. 4, p. 337-368, illus., tables, 1971.

00993

A neutron activation procedure for Ag, Au, Bi, Br, Cd, Cs, Cu, Ga, In, Pd, Rb, Te, Tl, and Zn has been developed and applied to 12 chondrites. Correlations between abundance and petrologic type were found for Bi, Br, Cs, In, and Tl; these elements correlated with each other and with primordial Ar and Xe. Apparently most fractionations of volatile elements, including noble gases, arose in the solar nebula rather than in meteorite parent bodies. Accretion temperatures of L-chondrites were estimated from Bi and Tl contents; types 3 to 6 seem to have accreted in a 100° interval centered on 530°K. Temperatures derived from Bi and Tl contents are generally concordant, as expected for the two-component model of Larimer and Anders. An equation for the fraction of In condensed is derived from the In data, using the inferred accretion temperatures. — DBV

08554 **Keller, E. A.** Bed-load movement experiments, Dry Creek, California: Jour. Sed. Petrology, v. 40, no. 4, p. 1339-1344, illus., tables, 1970.

08594

Bed-load movement experiments demonstrate that 35 percent of the variability of the distance a bed-load particle will move can be explained by the variability of the bottom velocity in the vicinity of the particle, and that 68 percent of the variability can be explained by the combination of bottom velocity and particle parameters. The experiments also indicate that movement of particles through pools is influenced predominantly by differences in particle parameters, whereas movement through riffles is most influenced by differences in bottom velocity. — Author's abstract

08553 **Kelley, James C.; McManus, Dean A.** Hierarchical analysis of variance of shelf sediment texture: Jour. Sed. Petrology, v. 40, no. 4, p. 1335-1339, illus., tables, 1970.

A number of geological inferences are made from studies of the geographic distributions of sediment textural variables; however, total within-station variability must be available. To determine within- and among-sample variabilities, bottom sampling on the shelf of Washington was done in a stratified-multistage scheme on traverses placed by a systematic random scheme along the coast. Duplicate samples were taken at each of 450 stations, and duplicate analyses of nine variables were made. Sampling led to three levels of analysis of variance in which the F-ratios of the mean square among stations to that within stations are measures of the reliability of distributions. The most diagnostic variables for differentiating stations are percentage of

01259

sand, percentage of silt, sand/mud ratio, and median phi size. The least diagnostic is percentage of clay. — *from* Authors' abstract

08502 **Kesling, Robert V.** Micropaleontology — Mostly a little about much concerning many of the little, *in* Teaching paleontology — North Am. Paleont. Convention, Chicago, Ill., 1969, Proc., Pt. A: Lawrence, Kans., Allen Press, p. 27-39, illus., 1970.

Special techniques for disinterring microfossils from their matrix, observing their configuration, and examining their structure remain the introductory part of a micropaleontology course. Taxa are so numerous that no one masters them all; selectivity is necessary for the course, with scarcely more than a glance at certain groups. Not all of the many aspects of microorganisms can be investigated in depth even though they are significant. A few points can be treated in depth to illustrate how micropaleontology works. With careful planning, time can be reserved for a special project. — DBV

08674 **Kesling, Robert V.** *Drepanaster wrighti*, a new species of brittle-star from the Middle Devonian Arkona Shale of Ontario: Michigan Univ. Mus. Paleontology Contr., v. 23, no. 4, p. 73-79, illus., 1970.

A new brittle-star from the Arkona Shale, east of Arkona, Ontario, is assigned to *Drepanaster* of the oegophiuridan family Protasteridae. It is characterized by a small disk bearing only a few spines and by well-developed adambulacral plates bearing oral (groove) spines set in a deep cleft and long, subconical distal (vertical) spines. — *from* Author's abstract

00993 **Kessler, L. G., 2d.** Characteristics of the braided stream depositional environment with examples from the South Canadian River, Texas: Earth Sci. Bull., v. 4, no. 1, p. 25-35, illus., table, 1971.

Braided streams were apparently quite common in pre-Cretaceous times. The South Canadian River in panhandle Texas exhibits criteria for their recognition in the geologic record. Trenched bars in active parts of its channel reveal within an individual flood sequence parallel bedding, tabular cross-beds, and small ripple cross-laminations; some were punctuated by thin clay drapes settled out during waning flood conditions. Flood sequences were discontinuous downstream; overall valley patterns are reasonably straight. The anastomosing pattern of braided channels is an internal feature of the sand body deposited by various sequences of aggradation. The Canadian River sediments would be preserved as a thin lateral sand body with remnants of numerous overlapping channel sequences. Its daily discharge data indicate less than 40 days of catastrophic flooding in the last 32 years. Preserved braided stream deposits represent extremely high flow conditions of short time. — GDC

08594 **Khan, Ehsanullah.** Biostratigraphy and palaeontology of a Sangamon deposit at Fort Qu'Appelle, Saskatchewan [with French abs.]: Canada Natl. Mus. Nat. Sci. Pubs. Palaeontology, no. 5, 82 p., illus., tables, 1970.

Mammals were found in four gravel beds of the Pleistocene Echo Lake gravels which, with overlying sand beds, are about 80 feet thick and lie between 170 feet of overlying and 150 feet of underlying till. *Canis* sp., *Taxidea* sp., *Mammuthus* cf. *columbi*, *Equus scotti*, *Camelops* cf. *hesternus*, *Cervalces roosevelti*, *Bison latifrons*, *Symbos cavifrons* are described. The predominantly grazing animals indicate a temperate climate, though *Symbos* may have been cold adapted. The assemblage indicates that the gravels are interglacial stream deposits rather than outwash; biostratigraphic evidence suggests a Sangamon age. The 20-foot-thick upper sand bed, which yielded aquatic and terrestrial mollusks, is a periglacial deposit, representing either a cold phase within the Sangamon or the beginning of Wisconsin glaciation. — VMJ

01259 **Kim, Ki-Tae; Burley, B. J.** Phase equilibrium in the system $NaAlSi_3O_8$-$NaAlSiO_4$-H_2O up to 15 kb — A theoretical discussion: Canadian Jour. Earth Sci., v. 8, no. 5, p. 549-557, illus., table, 1971.

This discussion is based on the equilibrium composition of invariant phases in the system in question. Two new invariant points are predicted, I_5 at about 13 kb and 500°C where jadeite, nepheline hydrate I, analcite, nepheline, and water vapor coexist; and I_6 at about 0.5 kb and 375°C, where albite, nepheline, analcite, nepheline hydrate I, and water vapor coexist. The phase relations around four previously known invariant points including a singular point S_4 are examined and partly modified. The maximum P-T stability field of subsolidus analcite is extremely large, that of liquidus analcite very limited. Most primary analcite is attributed to crystallization from water-undersaturated melt. — DBV

01260 **Kim, Ki-Tae; Burley, B. J.** The solubility of water in melts in the system $NaAlSi_2O_6$-$NaAlSiO_4$-H_2O: Canadian Jour. Earth Sci., v. 8, no. 5, p. 558-571, illus., tables, 1971.

The solubility of water in melts in the system in question has been determined up to 10 kb. The water-solubility in the melts is not too sensitive to variation in anhydrous composition of the melts. Water solubility in the (Anl) and (Ne) univariant melts was determined up to 10 kb. The origin of water bubbles in quenched hydrous glasses in this system is attributed to separation of dissolved water from the melts upon quenching. The method was extended to determine the water content in hydrous minerals, analcite, nepheline hydrate I, and zeolite species P_2 encountered in the system; results are in fairly good agreement with those of other authors. — DBV

King, Chi-Yu. *See* Healy, J. H. 01082

08444 **Kingsbury, Robert C.** An atlas of Indiana: Indiana Univ. Dept. Geography Occasional Pub. 5, 94 p., illus., 1970.

This thematic atlas of Indiana presents 109 small-scale maps of the state showing natural conditions and human activities. Included are maps on glacial and bedrock geology, soils, ground water, and mineral resources. — EH

Kinney, Edward E. *See* Zeller, Robert A., Jr. 08647

08576 **Kirkland, D. W.; Frederiksen, N. O.** *Cordaitina* pollen from Pennsylvanian strata of Oklahoma and Texas: Rev. Palaeobotany and Palynology, v. 10, no. 3, p. 221-231, illus., tables, 1970.

Specimens of the monosaccate pollen genus *Cordaitina* are common in Middle and Upper Pennsylvanian strata of north central Texas and the Anadarko basin of Oklahoma and Texas. *Cordaitina readi* n.sp. and *Cordaitina coalensis* (Dempsey) n.comb. are usually oval in outline and have a polygonally aerolate exoexine over the central body. The genus *Solisisporites* Dempsey is considered synonomous with *Cordaitina* Samoilovich. — Authors' summary

Kistler, R. W. *See* Shaw, H. R. 01311

01384 **Kistler, R. W.; Evernden, J. F.; Shaw, H. R.** Sierra Nevada plutonic cycle — Pt. 1, Origin of composite granitic batholiths: Geol. Soc. America Bull., v. 82, no. 4, p. 853-868, illus., tables, 1971.

Intrusion of Mesozoic batholiths in the western North American Cordillera began in the Late Triassic 210 m.y. ago and ended in the Late Cretaceous 80 m.y. ago. Emplacement of granitic rocks took place during five major epochs at about 30 m.y. intervals, each epoch taking 10 to 20 m.y. to complete. Transgressions and regressions of epicontinental seas in the midcontinent are correlated with the batholithic cycle to the west. The locus of granitic rocks was a source of sediments during most of the time of batholithic emplacement; the origin of the magmas cannot be related only to localized downwarping of geosynclines. The source of most of the mobile granodioritic magma was within the mantle, as shown by Sr isotope data. Exposed plutons were emplaced at depths as shallow as 4 km or less. The spatial relationships and other data are accounted for by northwestward drift of western North America onto and across a Mesozoic feature like present-day oceanic rises. — *from* Authors' abstract

08546 **Klein, George deVries.** Depositional and dispersal dynamics of intertidal sand bars: Jour. Sed. Petrology, v. 40, no. 4, p. 1095-1127, illus., tables, 1970.

A causal connection between time-velocity asymmetry of tidal currents and bar topography for intertidal sand bars in Minas basin, Nova Scotia, can be demonstrated. Such bar topography and zones of flood- or ebb-dominated bottom tidal currents control the distribution of sediment texture and sedimentary structures. The size of directional properties is hierarchically sensitive to dispersal history. Thirteen physical criteria, characteristic of tide-dominated sand bodies are listed. — HRC

Kleinhampl, F. J. *See* Davis, W. E. 01026

01344 **Klepper, M. R.; Robinson, G. D.; Smedes, H. W.** On the nature of the Boulder batholith of Montana: Geol. Soc. America Bull., v. 82, no. 6, p. 1563-1580, illus., tables, 1971.

Hamilton and Myers (1967) interpreted the Boulder batholith of western Montana to be "in effect a gigantic mantled lava flow. . . only a few kilometers thick," that flowed, under a crust of its own ejecta, across a broad structural basin. Such an interpretation is inconsistent with abundant geologic and geophysical data. The main mass of the batholith does not have the characteristics of a lava flow, its volcanic cover was not a floating cap but a laterally stable roof, and it does not thin toward its edges but is generally steep sided. Its flow structures are predominantly steep rather than near horizontal. Its emplacement required more than 4 m.y., a rate orders of magnitude too slow for a single sheet only a few kilometers thick. Gravity data suggest to us that the batholith is more than 15 km thick, as do heat flow, cooling rate, and seismic data. — *from* Authors' abstract

Knoll, Kenneth M. *See* Bayer, Thomas N. 01238

01150 **Koch, George S., Jr.; Link, Richard F.** The coefficient of variation — A guide to the sampling of ore deposits: Econ. Geology, v. 66, no. 2, p. 293-301, illus., tables, 1971.

The ratio of standard deviation to mean, C, is the coefficient of variation. "A plot of means and C values, calculated from 50,057 observations for amounts of various substances in 484 ore deposits, establishes an empirical relation between the mean and C and indicates probable values of C for various substances." C is high for trace elements and must approach O as mean approaches 100. This statistic can be used as a guide to the number of samples needed for a specified precision, to the form of statistical distribution appropriate for data analysis, and for quality control of sampling. — WSW

Koch, George S., Jr. *See* Link, Richard F. 08610

08655 **Kolessar, Joseph.** Geology and copper deposits of the Tyrone district, *in* Guidebook of the Tyrone-Big Hatchet Mountains-Florida Mountains region — New Mexico Geol. Soc. Field Conf., 21st, 1970: Socorro, N. Mex., New Mexico Bur. Mines and Mineral Resources, p. 127-132, illus., 1970.

The Burro Mountains mining district of Grant County is divided by the alluviated Mangas valley. Northeast, Little Burro Range follows the northwest-trending Mangas fault; Precambrian granite and Cretaceous sediments, intruded by andesite and rhyolite, are overlain by Tertiary volcanic flows. Southwest are the Big Burro Mts., Precambrian granite intruded by many dikes of diverse composition and age and by a quartz monzonite porphyry laccolith of Laramide age, exposed northeast of the mountains. Here, in a wedge-shaped horst tilted by the Burro Chief fault, is the Tyrone ore body, a supergene blanket of erratic chalcocite. Two major periods of primary mineralization followed the laccolith intrusion: copper, iron, zinc, and molybdenum, Laramide; fluorite, uranium, lead, and precious metals, late Tertiary. Sericite is the most abundant hydrothermal alteration product; also noted are higher-level kaolinization, widespread chloritization, and peripheral propylitization. — GDC

01396 **Komar, Paul D.** Hydraulic jumps in turbidity currents: Geol. Soc. America Bull., v. 82, no. 6, p. 1477-1487, illus., 1971.

By analogy with streamflow, turbidity currents should be supercritical (Froude number greater than unity) while passing through submarine canyons and subcritical (Froude number less than unity) in the upper submarine fan channel. The change in flow regime requires a hydraulic jump in the vicinity of the canyon mouth. Analysis of jumps in turbidity currents is based on solutions of the momentum flux equation and the equation resulting from assumption of a continuity of sediment flux. For the average submarine canyon-channel system, the flow would more than double in thickness and its velocity would be halved during a hydraulic jump. Turbulence would help to insure suspension of its sediment. — *from* Author's abstract

01209 **Kontrovitz, Mervin.** A new Holocene species of *Echinocythereis* (Ostracoda): Tulane Studies Geology and Paleontology, v. 8, no. 3, p. 166-168, illus., 1971.

This paper describes a new ostracod species, *Echinocythereis spinireticulata*, from the Louisiana continental shelf southwest of the Mississippi delta. Living genera have been found only in marine waters and usually on the outer continental shelf or at great depths; the specimens in this study were recovered from water depths of 136 to 150 feet. It was not possible to analyze the nature of the sediments because the samples were washed prior to acquisition, but the sediments in the recovery area are reported to be a mixture of sand and mud. — DBV

01039 **Korringa, M. K.; Noble, D. C.** Distribution of Sr and Ba between natural feldspar and igneous melt: Earth and Planetary Sci. Letters, v. 11, no. 2, p. 147-151, illus., 1971.

Interpretation of available modal and chemical data on porphyritic volcanic rocks and their constituent phases using a simple ideal fractional crystallization (Rayleigh) model yields the following approximate plagioclase-liquid distribution coefficients for Sr: An_{90}, 7.0; An_{45}, 5.4; An_{60}, 3.8; An_{75}, 2.3; An_{90}, 1.5. Plagioclase-liquid distribution coefficients for Ba vary linearly from about 0.42 at An_{30} to about 0.16 at An_{90}. The Sr/Ca ratio of sodic plagioclase appears to be slightly greater than that of the associated melt. Distribution coefficients for Sr and Ba between sodic alkali feldspar and salic melt appear to be about 3 to 4 and 3 to 5, respectively. The Sr/Ca ratio of alkali feldspar is at least several times that of coexisting melt. — Authors' abstract

Koteff, Carl. *See* Oldale, R. N. 01023

Kottlowski, Frank E. *See* Greenwood, Eugene. 08649

01387 **Kraft, John C.; Margules, Gertrude.** Sediment patterns, physical characters of the water mass and Foraminiferida distribution in Indian in Indian River Bay, coastal Delaware: Southeastern Geology, v. 12, no. 4, p. 223-252, illus., 1971.

The physiographic setting, bottom sediment facies patterns, salinity, temperature, pH, Eh, and organic content of the water mass and bottom sediments of the Indian River Estuary have been compared with the distribution of living benthonic Foraminiferida. Twelve genera, including 23 species of Foraminiferida, have been tentatively identified and separated into six geographically defined facies groups. No significant correlation was found between patterns of foraminiferal abundance and distribution of sediment types, nor between species occurrence and physical parameters observed. Foraminiferids living in this estuary system seem to be tolerant of highly varied bottom sediment types and physical characteristics of the water mass. — *from* Authors' abstract

08584 **Krantz, Grover S.** Human activities and megafaunal extinctions: Am. Scientist, v. 58, no. 2, p. 164-170, illus., 1970.

The case is made that Man's modification of the environment may have caused the demise of some large Pleistocene mammals. Man as a predator and as a competitor has been very influential in lowering the numbers of large animals. Many indirect causes can also be detected. It is suggested that Man killed all ages of animals,

whereas other natural predators selectively took the very young and the very old. During the winter, the carnivores of the area were starved out because Man had taken the old which the carnivore would normally take, and with the carnivores gone, the favored prey may have actually expanded, as did the buffalo. The ecological pressure from the bison may have forced the mammoth to extinction. — HRC

08625 **Krinsley, David; Cavallero, Lillian.** Scanning electron microscopic examination of periglacial eolian sands from Long Island, New York: Jour. Sed. Petrology, v. 40, no. 4, p. 1345-1350, illus., 1970.

A sand deposit in Nassau County, Long Island, New York has been determined as Pleistocene rather than Cretaceous in age by the use of scanning electron microscopy. Additionally, using the same techniques, a method has been established for distinguishing periglacial eolian sands in the fossil record from other types of glacial and eolian deposits. A series of events representing several glacial, several eolian and at least one solution episode has been noted on a sand sample from the same locality. — Authors' abstract

08477 **Kruger, P.; Channell, J. K.** Use of rare-earth elements as tracers in estuaries *in* Isotope hydrology, 1970 — A symposium, Vienna, Austria, 1970, Proc.: Vienna, Austria, Internat. Atomic Energy Agency STI-Pub. 255, p. 869-883, illus., tables, 1970.

For large hydrology systems, such as estuaries, stable-isotope tracing, with activation analysis, retains the sensitivity of radiation measurement without chemical problems of dyes and radiation problems of radioisotope tracers. Rare-earth elements have favorable nuclear, chemical, physical, and low natural abundance properties which make them suitable as tracers for flow and dispersion studies in estuaries. Post-sample treatment of irradiation in a 10-kW nuclear reactor, radiochemical group separation, and gamma-ray spectroscopy yield detection limits of 1 ng for europium, and 20 ng for lanthanum. The method was tested in San Francisco Bay where background concentration of lanthanum is 180 ng per l and of europium 12 ng per l. It can be used for tracing hydraulic flow or for persistence studies of suspended solids or settleable solid components. As many as six rare-earth elements can be measured simultaneously and can be used in conjunction with radioactive rare-earth elements to extend tracing time or dilution range. — *from* Authors' abstract

08617 **Krumbein, W. C.** Geological models in transition, *in* Geostatistics — A colloquium (D. F. Merriam, editor), Lawrence, Kan., 1970, Proc.: New York, Plenum Press, p. 143-161, illus., 1970.

The past decade saw the transition from dominantly univariate statistical procedures to increasingly multivariate techniques as the influence of computers spread throughout geology. The accompanying rapid rise of the model concept brought diversity in methods of structuring data for search procedures and predictor models. The general linear model easily rose to dominance in this domain. Simulation models drew attention to the need for more analytical structuring of geologic models. This paper discusses the problems in the contexts of stratigraphic analysis and stream networks in geomorphology. — DBV

Krummel, W. J., Jr. *See* Hinrichs, E. N. 01007

Krummel, W. J., Jr. *See* Hinrichs, E. N. 01008

01299 **Kurtz, V. E.** Upper Cambrian Acrotretidae from Missouri: Jour. Paleontology, v. 45, no. 3, p. 470-476, illus., table, 1971.

Six species (4 new) of phosphatic inarticulate brachiopods in three acrotretid genera are described and illustrated by stereographs. The 2,900 specimens were obtained from formic-acid residues of limestone from cores of a 50-ft interval in the upper Bonterre Formation, southeastern Missouri, spanning the middle of the Pterocephaliid Biomere, including the upper *Aphelaspis*, *Dunderbergia*, and Lower *Elvinia* trilobite zones. The new species are *Angulotreta missouriensis*, *Apsotreta at-*

tenuata, A. stricta, Linnarssonella costa. Zonation based on the brachiopods is more precise than, and not coincident with, that based on trilobites through this interval. — REG

01153 **Kutina, Jan.** The Hudson Bay paleolineament and anomalous concentration of metals along it: Econ. Geology, v. 66, no. 2, p. 314-325, illus., 1971.

The name "Hudson Bay paleolineament" is proposed for "a significant north-south trending geofracture in the Canadian Shield, the trace of which has been displaced at several places along other fractures." It forms the eastern boundary of Paleozoic sedimentation in Hudson Bay, and can be traced south from James Bay, by study of drainage patterns and the distribution of aeromagnetic anomalies. A northern extension may be represented by the Paleozoic-Precambrian boundary on Ellesmere Island or the submarine rift valley between that island and Greenland. Noranda and Cobalt occur at intersections of this lineament with fractures of other sets. — WSW

01214 **Kwan, D.** Observations of the failure of a vertical cut in clay at Welland, Ontario [with French abs.]: Canadian Geotech. Jour., v. 8, no. 2, p. 283-298, illus., table, 1971.

Results of an instrumented test excavation in Welland clay are presented with analysis, discussion, and conclusions. The field investigation includes an observation of a deep vertical slope failure as well as an inclined stable slope, and measurements of pore pressure and surface strain. The average *in situ* undrained strength indicates that the soil deposit excavated in the area is not soft. — Author's abstract

Lachenbruch, Arthur H. *See* Sass, J. H. 01084

08700 **Lajoie, J. J.; Caner, B.** Geomagnetic induction anomaly near Kootenay Lake — A strike-slip feature in the lower crust,: Canadian Jour. Earth Sci., v. 7, no. 6, p. 1568-1579, illus., 1970.

A geomagnetic induction anomaly in southeastern British Columbia has been investigated in detail with a 20-station network. The results indicate a sharp (near vertical) discontinuity in deep electrical conductivity structure, trending roughly east-west and located at the south end of Kootenay. It is interpreted as evidence for sinistral strike-slip which intersected the edge of the main conductive layer which underlies most of the western Cordillera. Geological evidence indicates that such a feature (which has no known surface expression) must predate the late Paleozoic or early Mesozoic (200-250 m.y.). The persistence of sharp discontinuities over such long periods would confirm the compositional, rather than thermal, nature of the lower crustal conductive layer under the western Cordillera. — Author's abstract

01092 **Lajtai, E. Z.** A theoretical and experimental evaluation of the Griffith theory of brittle fracture: Tectonophysics, v. 11, no. 2, p. 129-156, illus., 1971.

Plaster of Paris models, with single elliptical or circular voids of varying size and orientation, were loaded under uniaxial compression. Initial fractures, at points of maximum tension, propagated into a direction parallel with applied load. Orientation of critical cracks (at lowest stress) differed from that predicted by Griffith theory; for all elliptical shapes the major axis was perpendicular to direction of uniaxial load. For every critically oriented crack there appeared to be a critical size; cracks greater than the critical size initiated first fractures when applied stress reached the tensile strength of surrounding material. Voids and cracks smaller than the critically oriented and sized crack initiated fractures at higher stresses. First-formed fractures did not lead to collapse of test models; with increasing stress, shearing around the crack periphery initiated new tension fractures before ultimate rupture. — GDC

08458 **Lamar, Donald L.** Geology of the Elysian Park-Repetto Hills area, Los Angeles County, California: California Div. Mines and Geology Spec. Rept. 101, 45 p., illus., tables, geol. map, 1970.

This area is in a group of low hills and intervening lowlands at the northern edge of the Los Angeles basin comprising a densely populated part of Los Angeles. Basement rocks are massive granodiorite and quartz diorite in the northwest part and gneissic quartz diorite and minor schist and granodiorite on the east. Basement rocks are faulted against sedimentary rocks along Hollywood, Eagle Rock, and San Rafael Faults; thickness and lithology of sedimentary rock units differ within individual fault blocks. The Cretaceous(?) crystalline and Tertiary to Holocene sedimentary rocks and major faults are described in detail. The petroleum geology of three fields within the area is summarized very briefly; exploratory wells and selected oil-producing wells through Dec. 31, 1965 are tabulated. — VSN

Lambert, T. William. *See* Mull, D. S. 01375

08557 **Land, Lynton S.** Carbonate mud — Production by epibiont growth on *Thalassia testudinum*: Jour. Sed. Petrology, v. 40, no. 4, p. 1361-1363, table, 1970.

Epibiotic growth of coralline red algae and serpulid worms in the marine turtle grass *Thalassia testudinum* is sufficient to produce carbonate mud at rates comparable to the rates of accumulation of ancient platform carbonates. — Author's abstract

Landisman, M. *See* Mitchell, B. J. 01293

08666 **Langston, Wann., Jr.** A fossil ray, possibly *Myledaphus* (Elasmobranchii:Batoidea) from the Late Cretaceous Oldman Formation of western Canada [with French abs.]: Canada Natl. Mus. Nat. Sci. Pubs. Palaeontology, no. 6, 15 p., illus., 1970.

A large batoid fish is described from the Oldman Formation in southeastern Alberta, within 11 miles of the only other fairly complete fish skeleton reported from the Oldman (an elopid teleost described by Bardack, ibid., no. 3, 1970). The specimen comprises the anterior part of the axial skeleton including a distorted chondrocranium, ankylosed synarcual plate, and an articulated series of 28 "free" vertebrae; X-ray radiography showed that visceral and appendicular skeletons are missing. No teeth nor dermal denticles are preserved. A combination of negative and circumstantial evidence, including the abundance in the Oldman Formation of scattered teeth of the dasyatid ray *Myledaphus*, suggests assignment to that genus. Occurrence of an elasmobranch does not contraindicate a freshwater origin for the Oldman deposits in this area. — VMJ

01184 **Langstroth, Ward T.** Seismic study along a portion of the Devonian salt front in North Dakota: Geophysics, v. 36, no. 2, p. 330-338, illus., 1971.

A study which covers portions of Bottineau, McHenry, Ward, and Renville Counties, North Dakota is described. Conventional seismic data and deep well control combine to form an ideal model for study of the Devonian Prairie salt and its effects on overlying [petroleum] reservoir beds. The trapping mechanism in one oil field and reasons why several structures are dry can be explained with the results of this review. — Author's abstract

Lanphere, Marvin A. *See* Moore, William J. 01154

01346 **Larson, Edwin E.; Mutschler, Felix E.** Anomalous paleomagnetic pole from isotopically dated Cambro-Ordovician intrusives in Colorado: Geol. Soc. America Bull., v. 82, no. 6, p. 1657-1666, illus., tables, 1971.

Paleomagnetic data from dated plutons in central Colorado indicate a Cambrian-Ordovician paleopole close to the late Paleozoic pole position. Samples demagnetized by ac and thermal techniques yielded the same magnetic directions. Polished section and Curie temperature analysis indicate that the principal magnetic phase is low-Ti titanomagnetite. These and other studies indicate that the magnetization is thermoremanent magnetization, and they suggest that either little polar wandering occurred between the early and late Paleozoic or by late Paleozoic time the paleopole had returned to a position that was nearly coincident with that of the early Paleozoic. — *from* Authors' abstract

01309 **Larson, Roger L.** Near-bottom geologic studies of the East Pacific Rise crest: Geol. Soc. America Bull., v. 82, no. 4, p. 823-841, illus., 1971.

A survey with near-bottom instruments was made over a 15-km by 25-km area of the East Pacific Rise crest at the mouth of the Gulf of California. The abyssal hills that compose the rise crest are approximately 5 km wide, 200 m high, and are elongate parallel to the northeast trend of the rise. They have been formed by a combination of faulting and volcanism at the rise crest. In addition to producing relief, volcanism is also a means of smoothing relief in this region. A zone 22 km wide at the rise crest is essentially barren of sediment. Sediment is present on both sides of this bare zone. The boundary between the Pacific and American plates at the rise crest is a very precise and narrow feature that lends itself to two definitions. The first is the center of intrusion which was about 100 m wide during the last three magnetic field reversals and probably has been similarly as narrow for at least the past 1.2 m.y. The second definition of the plate boundary is a rift-defined zone of crustal extension at the axis of the rise crest. — *from* Author's abstract

01237 **Lasmanis, Raymond.** Upper Devonian fossil locality: Earth Sci., v. 24, no. 1, p. 15-18, illus., 1971.

The collecting site is along bluffs of the Hay River, western and northwestern bank, between the towns of Enterprise and Hay River, Northwest Territories. A ledge of brachiopod-rich argillaceous limestone is exposed at summer water level, containing many crinoid columnals. Corals, brachiopods, and mollusks are abundant in the upper B member of the Hay River Formation. Coelenterates, echinoderms, annelids, bryozoa, and arthropods were also collected. — ESL

Lattimore, Robert K. *See* Weeks, L. Austin. 01159

Laurin, A.-F. *See* Chown, E. H. 08469

01146 **Lavery, N. G.; Barnes, H. L.** Zinc dispersion in the Wisconsin zinc-lead district, *with* an appendix, Zinc and lead in common sedimentary rocks, by K. H. Wedepohl: Econ. Geology, v. 66, no. 2, p. 226-242, illus., tables, 1971.

The curvature of primary zinc dispersion curves and the concentration at any point are shown to be functions of the distance from and size of mineralized zones, and such curves are therefore potential exploration guides. Assuming a model in which zinc, in a chloride complex, diffuses from a fracture containing ore solution through brine-saturated pores to be adsorbed on carbonate grains, the minimum concentration of zinc in the fracture and the length of time for mineralization can be calculated. The applicable dispersion equations were evaluated using experimental values for the diffusion coefficient. Two measured dispersion curves suggest concentrations of about 35 and 200 ppm Zn times of 2.5×10^5 and 2×10^5 years, respectively. — WSW

08473 **Lawson, D. W.** A rational approach to groundwater investigations in representative basins [with French abs.], *in* Symposium on the results of research on representative and experimental basins: Internat. Assoc. Sci. Hydrology-Unesco Pub. 96, p. 652-667, illus., table, 1970.

A rational approach to groundwater investigations in representative basins is developed. The approach consists of three interrelated parts; (1) a flow system analysis, (2) a groundwater storage analysis, and (3) an analysis of the mechanisms of groundwater recharge and discharge. The application of part (1) of the approach is illustrated by an investigation of the groundwater flow systems in the crystalline rocks of the Trapping Creek Representative Basin. The Trapping Creek Basin is centrally located in the Okanagan Highland; a highly dissected plateau in the Southern Interior Plateau of British Columbia, Canada. — Author's abstract

01391 **LeBreton, E. Gordon.** Hydrogeology of the Red Deer area, Alberta: Research Council Alberta Rept. 71-1, 14 p., table, geol. map, 1971.

Most wells in this area are completed in near-surface bentonitic siltstone and local sandstone beds of Paskapoo Formation, and bentonitic siltstones and thin bedded sandstones, coal and carbonaceous shales of Edmonton Formation. Apart from sand and gravel in preglacial valleys, surficial deposits are not an important source of ground water. Yields from 500 to less than 1 imperial gpm in the low rolling eastern part, limit supplies for rural domestic, livestock, and perhaps municipal use. High ground in the west generates ground-water flow, discharged in springs, salt deposits, and flowing wells. Near-surface ground waters are predominantly sodium-bicarbonate and sodium-sulfate types; total dissolved solids, less than 1000 ppm in west, increase eastwards to over 2000 ppm; in the western part, quality for drinking is good to depths of 1000 feet. — *from* Author's abstract

Lee, Della I. *See* Smith, Merritt B. 01086

08529 **Lefebvre, Richard H.** Columbia River basalt of the Grand Coulee area, *in* Columbia River Basalt Symposium, 2nd, Cheney, Wash., 1969, Proc.: Cheney, Eastern Washington State College Press, p. 1-38, illus., tables, 1970.

This paper summarizes the stratigraphy, petrography, and petrology of some of the late Yakima Basalt flows in the Grand Coulee area. The uppermost flow of the Roza Member is discussed in detail, and a model is formulated to explain the characteristics of this flow with regard to flood basalt petrogenesis: extrusion of great quantities of low viscosity lava that spread rapidly over vast areas, forming ponds or lakes. Flood basalts are not the consolidated equivalent of moving lava flows, but represent crystallization of large ponds of lava. — DBV

01286 **LeGrand, H. E.; Stringfield, V. T.** Differential erosion of carbonate-rock terranes: Southeastern Geology, v. 13, no. 1, p. 1-17, illus., 1971.

Relief in carbonate-rock terranes may be local and small as expressed by many shallow sinkholes, or large as expressed by poljes and escarpments. There is commonly significant relief between a belt of carbonate rocks and adjacent noncarbonate rocks; cuesta topography occurs where adjacent rocks are slightly inclined. Carbonate rock valleys between sandstone ridges are common in some humid regions, but ridge-forming carbonates between shale valleys are also common. Differential erosion results from a combination of physical and chemical processes. Rock must be decomposed or disintegrated before it can be physically removed, and a permeable soil cover is necessary for effective solution of carbonate rocks. Denuded carbonate rocks are much more resistant to physical and chemical erosion than are those with a moderately thin soil and vegetal cover. — *from* Authors' abstract

01193 **Leisman, G. A.; Bucher, J. L.** Variability in *Calamocarpon insignis* from the American Carboniferous: Jour. Paleontology, v. 45, no. 3, p. 494-501, illus., table, 1971.

Calamocarpon insignis Baxter, 1963, from the Middle and Upper Pennsylvanian of central U.S., is a monosporangiate, heterosporous arthrophytic cone. The megasporangiate cone is noteworthy because only one functional megaspore occurs in each sporangium. The present study reveals sufficient variation from the original description that an emended diagnosis is warranted. — SHM

Lenhoff, Charles J. *See* Hunt, Graham R. 00996

01361 **Leonard, A. Byron; Frye, John C.; Johnson, W. Hilton.** Illinoian and Kansan molluscan faunas of Illinois: Illinois Geol. Survey Circ. 461, 23 p., illus., 1971.

Kansan and Illinoian molluscan faunas from 28 localities in Illinois are listed by geographic location and stratigraphic position; eight of the faunas are of Kansan age, 21 are Illinoian, of which 11 are assigned to the Liman Substage and 10 to the Jubilean and Monican Substages. Though they occur largely in waterlaid sediments, these faunas are composed predominantly of terrestrial forms and they indicate an environment of forest-border, or mixed savanna and woodlands. Pleistocene molluscan faunas in Illinois are of minor value for stratigraphic correlation because of their essential similarity throughout the Quaternary. This history of faunal stability contrasts

sharply with data from the Great Plains, where marked compositional changes in faunas, resulting from ecologic changes, have occurred during Pleistocene time. — *from* Authors' abstract

01372 **Leopold, Luna B.; Clarke, Frank E.; Hanshaw, Bruce B.; Balsley, James R.** A procedure for evaluating environmental impact: U.S. Geol. Survey Circ. 645, 13 p., illus., 1971.

In response to an article in "Science," Gillette (1971), this report contains a procedure that may assist in developing uniform environmental impact statements. The heart of the system is a matrix general enough to be used as a reference checklist or a reminder of the full range of actions and impacts on the environment that may related to proposed actions. A generalized procedure for development of an action program is outlined. Four basic items in the environmental impact statement are presented, and the fourth, environmental impact assessment, is discussed at more length. An appendix applies matrix analysis to impact assessment of a phosphate mining lease. — ESL

Lewis, Anthony J. *See* Macdonald, Harold C. 01067

01037 **Lewis, John S.** Consequences of the presence of sulfur in the core of the Earth: Earth and Planetary Sci. Letters, v. 11, no. 2, p. 130-134, table, 1971.

As a direct consequence of the remarkable stability of alkali and alkaline metal sulfides, it is likely that potassium and several other elements not usually regarded as chalco- or siderophilic may be enriched in Earth's core. Decay of the radioisotope K-40 in the core may provide about 10^{20} erg/sec, 10^4 times the power required to maintain the Earth's magnetic field. Convection in the mantle will be driven strongly from below. The energy from decay of K-40 will be largely transported through the oceanic crust, while decay energy of U and Th will be lost through the top of the continental crust. The depletion of sulfur, the chalcophile elements, and the alkali metals in Earth's lithosphere relative to chondritic Earth models can be simply explained if sulfur, not silicon is the light component of the core. — Author's abstract

Lewis, Richard Q., Sr. *See* Taylor, Alfred R. 01021

Lewis, Richard Q., Sr. *See* Taylor, Alfred R. 01401

01369 **Lewis, Richard S.** The radioactive salt mine: Bull. Atomic Scientists, v. 27, no. 6, p. 27-34, 1971.

Plans for the disposal of radioactive wastes from nuclear fuel reprocessing plants in salt beds northeast of Lyons, Kansas, have not been approved by the State of Kansas. It is felt that the experimental analyses of heat flow from the buried wastes and of its geologic effects on salt beds and rock structures sealing the salt above and below are not satisfactory. There is also the problem of how such wastes could be recovered, once the stainless steel and ceramic containers have disintegrated (three years or less), in the event of an accident exposing them to the environment or to flowing water. Addenda by William W. Hambleton, Director of the Kansas Geological Survey and by F. L. Culler, Deputy Director of Oak Ridge National Laboratory discuss plans for further tests. A summary is given of the AEC environmental statement. — VSN

01235 **Liberty, B. A.** Paleozoic geology of Wolfe Island, Bath, Sydenham and Gananoque map-areas, Ontario: Canada Geol. Survey Paper 70-35, 12 p., geol. maps, 1971.

Cambrian and Middle Ordovician rocks of the Kingston area progressively onlap Precambrian rocks of the Canadian Shield and are in turn overlain by surficial Pleistocene deposits. Nomenclature used in the area is adopted from that previously proposed by Liberty. The succession has been mapped from northern Michigan into northern New York State. Formations described include the Cambrian Potsdam, and Ordovician Shadow Lake Formation and the Simcoe Group, which is divisible into Gull River, Bobcaygeon, Verulam, and Lindsay Formations in ascending order. Four

geologic maps (Map 17-20, 1970) included are for the Sydenham, Gananoque, Bath, and Wolfe Island areas. — VSN

01131 **Liebermann, Robert C.; Schreiber, Edward.** Elastic properties of minerals, *in* Tectonophysics, U.S. National Report, 1967-1971, Fifteenth General Assembly, IUGG: EOS, v. 52, no. 5, p. IUGG 142-147, 1971.

This summary highlights the major advances in the measurement of pressure and temperature dependence of the elastic properties of rock-forming minerals; measurement of ambient properties of other minerals and rocks; study of the effect of rock fabric, porosity, and fluid content on the elastic properties of polycrystalline aggregates; development of new experimental techniques; and establishment of systematic trends in the data leading to formulation of semi-empirical equations of state relating the zero-pressure elastic properties of minerals. For details the reader is referred to the bibliography. — DBV

01120 **Lindsley, D. H.** Experimental igneous petrology, *in* Volcanology, Geochemistry and Petrology, U.S. National Report, 1967-1971, Fifteenth General Assembly, IUGG: EOS, v. 52, no. 5, p. IUGG 67-73, 1971.

This is a summary and bibliography of experimental igneous petrology in the United States in the past four years. To hold the bibliography to manageable proportions, the scope of the report has been mostly confined to studies in which silicate liquids were produced, to determinations of subsolidus relations having a direct bearing on the formation or crystallization of magmas, and to fluid phases coexisting with melts or with solid phases at high temperatures. The two most exciting developments affecting igneous petrology have been those in plate tectonics and lunar exploration. — DBV

Link, Richard F. *See* Koch, George S., Jr. 01150

08610 **Link, Richard F.; Koch, George S., Jr.** Experimental designs and trend-surface analysis, *in* Geostatistics — A colloquium (D. F. Merriam, editor), Lawrence, Kan., 1970, Proc.: New York, Plenum Press, p. 23-29, illus., tables, 1970.

This paper indicates how the choice of a model may influence the method of data collection, and relates trend-surface analysis to analysis of variance. One illustration of a good design for a quadratic trend model is given. This topic has relevance to geologists who are interested in trend-surface analysis, particularly to those who have responsibility of designing drilling patterns. — Authors' abstract

08499 **Linsley, Robert M.** Undergraduate paleontology in a liberal arts college — Or, "How many thousand genera do they really need to know?" *in* Teaching paleontology — North Am. Paleont. Convention, Chicago, Ill., 1969, Proc., Pt. A: Lawrence, Kans., Allen Press, p. 3-12, 1970.

A classical course in paleontology is outlined, and the success of such a course is evaluated in terms of the goals of education. The ultimate goal of any science course is an attainment by the students of an awareness of the creativity, spontaneity, and joy inherent in science. Paleontology could be the most "relevant" course in a student's educational career, because "relevance" is concerned with attitudes and approaches. Educational goals are best served by emphasizing the significance of concepts rather than by blind memorization of a host of terms. The goal most difficult to achieve in the ideal educational system is to bring about a "colleague" relationship between teacher and students; to accomplish this means abandoning the lecture system. A paleontology course which might achieve these goals is proposed. — DBV

01395 **Lockwood, J. P.** Sedimentary and gravity-slide emplacement of serpentinite: Geol. Soc. America Bull., v. 82, no. 4, p. 919-936, illus., table, 1971.

Large deposits of serpentinite in alpine-type orogenic areas have been formed by sedimentary processes ranging from the detrital accumulation of bedded serpentinite sandstone and shale to the emplacement of chaotic breccias (olistostromes) and gigantic slide blocks. Sedimentary serpentinites range from early Paleozoic to Quater-

nary age, although most are Cretaceous or Tertiary. Most are deposited in eugeosynclinal environments, early in the geosynclinal cycle. These serpentinites contain slightly more silica and alumina than nondetrital ones because of contamination. Upward-migrating serpentinite protrusions which penetrate the seafloor or Earth's surface upslope from depositional sites are postulated as the sources of the deposits. Many serpentinite masses of alpine-type orogenic areas may be sedimentary and coeval with enclosing sedimentary rocks. — RAL

Lofgren, Gary. *See* Heiken, Grant. 01319

Lorenz, Douglas M. *See* Bretsky, Peter W. 08520

01325 **Loring, Arthur P.; Wong, Kin K.** Re-evaluation of some Devonian Lebensspuren: Geol. Soc. America Bull., v. 82, no. 4, p. 1103-1105, illus., 1971.

Taonurus cauda-galli, a lebensspuren found in lower and middle Devonian rocks of the Appalachian region, has been referred to as a form of seaweed, worm burrows, in organic mineral markings, or wave markings of a peculiar type. A trace fossil resembling *T. cauda-galli* has been found at Fourth Lake, Ulster County, New York. The mode of preservation of this fossil and its similarity to *T. cauda-galli* indicate that both are marine plants of similar origin. — Authors' abstract

Loubat, H. *See* Aumento, F. 01247

01324 **Lovejoy, Earl M. P.; Hoffer, Jerry M.** Tectonic implications of a basaltic dike, southern Franklin Mountains, El Paso County, Texas: Geol. Soc. America Bull., v. 82, no. 4, p. 1115-1121, illus., table, 1971.

Cenozoic strike-slip movement on faults which bound the Franklin Mountains is indicated by strike-slip offset of a basaltic dike, which cuts a Cenozoic landslide breccia. — WHN

Low, P. F. *See* Davey, B. G. 01275

Lubke, E. R. *See* Rosenau, J. C. 01108

Lucas, A. L. *See* O'Brien, P. N. S. 01380

Lumbers, S. B. *See* Ayres, L. D. 01111

01352 **Lyons, John B.; Snellenburg, Jonathan.** Dating faults: Geol. Soc. America Bull., v. 82, no. 6, p. 1749-1751, 1971.

The timing of the absolute age of last motion along faults may be determined by the application of K/Ar techniques to the illitic fraction of fault gouges. Three examples of Late Triassic or Early Jurassic age from western New Hampshire are cited as evidence. — Authors' abstract

08495 **Lytle, William S.; Goth, Joseph H.** Oil and gas geology of the Kinzua quadrangle, Warren and McKean Counties, Pennsylvania: Pennsylvania Geol. Survey, 4th Ser., Bull. M 62, 99 p., illus., 1970.

This quadrangle has 28 known oil and/or gas fields, most established prior to 1900. Pennsylvanian, Mississippian, and upper Devonian sandstones, siltstones, and shales crop out in the area, and deepest wells reach Lower Devonian Oriskany sandstone and Silurian carbonates and salt. A regional southerly dip averages 35 feet per mi in Upper Devonian rocks and 45 feet per mi in Oriskany sandstone; imposed on this are broad, north-south folds. Most productive sands are in Clarendon rocks, Canadaway Group, Upper Devonian in age; these sands are described. Upper Devonian rocks in large areas of the quadrangle, especially in the northern third, have not been adequately explored. Appendixes give selected shallow- and deep-well records from the quadrangle. — VSN

MacDonald, Gordon J. J. *See* Urey, Harold C. 01254

01055 **MacDonald, H. C.; Waite, W. P.** Optimum radar depression angles for geological analysis: Modern Geology, v. 2, no. 3, p. 179-193, illus., tables, 1971.

High-resolution radar as a spacecraft sensor for mapping and resource evaluation is being investigated. Assuming that radar's most significant contribution would be in areas inaccessible to photography, careful consideration must be given to geometry of the imaging system and of the terrain. In low relief areas, oblique illumination can generally enhance topographic geologic features, but in rugged terrain, extensive shadowing and layover can hinder interpretation. Radar depression angle and terrain slope define the range over which shadow and layover will occur, but the extent of either is defined by relative relief. For most systems, interpretive data loss increases as terrain slopes exceed 35° and local relief surpasses 1,000 m. Near and far range depression angles have been recommended according to five global terrain categories; imaging altitudes are considered for both airborne and spaceborne platforms. — *from* Authors' abstract

01067 **Macdonald, Harold C.; Lewis, Anthony J.; Waite, William P.** Radar geomorphology in Louisiana coastal marsh and swamp [abs.]: Georgia Acad. Sci. Bull., v. 29, no. 2, p. 128-129, 1971.

MacGregor, I. D. *See* Garlick, G. D. 01227

Machado Martínez, Luis. *See* García Gutiérrez, Carlos. 08453

Machlan, L. A. *See* Garner, E. L. 01399

08426 **MacKay, D. K.** Electrical resistivity measurements in frozen ground, Mackenzie Delta area, Northwest Territories [with French abs.], *in* Symposium on the Hydrology of Deltas, V. 2: Internat. Assoc. Sci. Hydrology-Unesco Pub. 91, p. 363-375, illus., tables, 1970.

The use of resistivity in identification of frozen rock/soil types and in mapping the upper permafrost surface is discussed. Apparent resistivity ranges of some identifiable frozen materials are tabled. Of materials sounded, sands and gravels have the highest resistivities, silts the lowest, with peats falling into an intermediate category. Variations in topography, drainage, and vegetative cover may be useful indicators of relative differences in apparent resistivity. Ground temperature is an important factor affecting apparent resistivity; resistivity doubles for a drop of 1.5°C to 2°C in the top three meters of frozen gravels. Resistivity techniques are of use in mapping the upper permafrost surface, particularly in deltas where numerous heat sources such as channels and lakes influence configuration. Resistivity data complements seismic, drillhole, and ground temperature data in permafrost investigations. — *from* Author's abstract

MacLeod, N. S. *See* Snavely, P. D., Jr. 08642

01292 **Maher, Louis J., Jr.** An experiment in television geology at the University of Wisconsin — Madison, *in* Teaching introductory college geology by television — Council on Education in the Geol. Sci. Pub. 6: Washington, D.C., Amer. Geol. Inst., p. 30-34, illus., 1971.

This article describes an introductory geology course given by the author from the school year 1966-67 through 1968-69 on closed-circuit television at the University of Wisconsin's TV station. Preparation, costs, and instructional results are reviewed. The author concludes that the use of television in teaching is more expensive than traditional teaching techniques in relatively small classes, and that TV students do not necessarily learn more information, have better grades or a greater interest in taking further geology courses than students taking the regular course. — EH

Maley, Richard P. *See* Cloud, William K. 01169

Malfait, Bruce T. *See* VanAndel, Tjeerd H. 01340

Malhotra, R. *See* Hanson, G. N. 01323

Mallory, V. Standish. *See* Wheeler, Harry E. 08535

Mallory, V. Standish. *See* Wheeler, Harry E. 08536

08658 **Malone, Ph. G.; Towe, K. M.** Microbial carbonate and phosphate precipitates from sea water cultures: Marine Geology, v. 9, no. 5, p. 301-309, illus., 1970.

Difco Triptone and Difco Yeast extract were decomposed in sea water at about 24°C under varying aeriation conditions. Struvite formed in aerated cultures by a reaction between phosphate and ammonia from the organic material and magnesium in the sea water. Cultures from paper-plugged flasks produced struvite and monohydrocalcite precipitates. Cultures from tightly-stoppered flasks produced a precipitate consisting of calcite containing approximately 14 mol percent $MgCO_3$ and struvite. The uncomplicated nature of these experiments suggests that similar phases may be produced in varying natural solutions where nitrogenous organic material decays in sea water or in contact with interstitial water in sediments. — *from* Authors' abstract

08615 **Marechal, A.; Serra, J.** Random kriging, *in* Geostatistics — A colloquium (D. F. Merriam, editor), Lawrence, Kan., 1970, Proc.: New York, Plenum Press, p. 91-112, illus., 1970.

The aim of this paper is to show how, under certain conditions of mineralization and exploration, the kriging equations of G. Matheron can be simplified by the random kriging procedure. The kriging equations are briefly discussed, then different possibilities of simplification are considered, according to the size of panels to be estimated, i.e., large, medium or small in regard to the exploration mesh. In each situation, an example of application to the estimation of tonnage-mean ore grade curve in a bauxite lens is given. — Authors' abstract

01310 **Margolis, Stanley; Rex, Robert W.** Endolithic algae and micrite envelope formation in Bahamian oölites as revealed by scanning electron microscopy: Geol. Soc. America Bull., v. 82, no. 4, p. 843-851, illus., 1971.

Examination of Holocene Bahamian oölites by scanning electron and light microscopy has revealed the orientation of aragonite crystals in the lamellar oölitic envelope, and their modification by the boring activities of endolithic algae. Voids produced by algae are lined and filled with precipitated aragonite. Similarities in the fillings with described micrite suggest that further study will clarify our understanding of the micritization process. — *from* Author's abstract

Margules, Gertrude. *See* Kraft, John C. 01387

Mariacher, Burt C. *See* Rausch, Donald O. 08601

01295 **Marr, John D.** Seismic stratigraphic exploration, Pt. 1: Geophysics, v. 36, no. 2, p. 311-329, illus., 1971.

Seismic stratigraphic exploration must be described in such a way that management can visualize it as practical and potentially profitable with proven past accomplishments, with important new capability not yet in application, and with significant future potential. Past seismic capabilities are illustrated with three case histories covering the probable direct detection of a hydrocarbon-saturated sand (Fairbanks-North Houston area, Texas), the discovery of saturated lenticular sands over the area of a tilted out ancestral structure (Big Island area, La.), and the delineation of a flank type stratigraphic trap (Vinton dome north flank, La.). Three additional case histories will be presented in Part 2. — DBV

01250 **Martignole, J.; Schrijver, K.** Association of (hornblende-)garnet-clinopyroxene "subfacies" of metamorphism and anorthosite masses [with French abs.]: Canadian Jour. Earth Sci., v. 8, no. 6, p. 698-704, illus., 1971.

The anorthosite masses of the Adirondacks (New York) and Morin (Quebec) are surrounded by rocks in many of which occur symplectites of garnet and quartz between orthopyroxene and plagioclase and between iron (-titanium) oxides and

plagioclase. Evidence is given here to show that the distribution of the mineral assemblages is not the expression of a single gradient in pressure or temperature, but that the anorthosite-mangerite suite completed solidification under a load pressure of 8-10 kb and retarded regional cooling to permit the garnet-quartz-forming reactions to occur both in the anorthosite-mangerite and in contiguous rocks. — VSN

Marvin, Richard F. *See* Zartman, Robert E. 01313

08614 **Matheron, G.** Random functions and their application in geology, *in* Geostatistics — A colloquium (D. F. Merriam, editor), Lawrence, Kan., 1970, Proc.: New York, Plenum Press, p. 79-87, 1970.

Many regionalized variables occurring in geology may be interpreted as a realization (sample functions) of random functions (RF). The powerful tools of the RF theory, therefore, may be used to describe and explain properties of geological phenomena as well as solving practical problems. Geostatistics in the strict sense are based on the variogram of a stationary (or, more generally, intrinsic) RF and imply applications in mining estimation. In the nonstationary case, universal kriging procedures give the best possible estimator of a trend (drift) and may be applied to contouring problems. This paper examines what minimal probabilistic characteristic of RF is necessary to solve a given practical problem (global or local linear estimation), and what hypothesis is required for a possible estimation of this minimal characteristic. — Author's abstract

Mathur, Surendra P. *See* Adams, William M. 08595

01213 **Matich, M. A. J.; Stermac, A. G.** Settlement performance of the Burlington Bay Skyway [with French abs.]: Canadian Geotech. Jour., v. 8, no. 2, p. 252-271, illus., 1971.

The Skyway is founded on a deep baymouth bar, believed to be about 10,000 years old and to be normally loaded with respect to present ground level. Under the northern half of the bar there is a considerable depth of clay, also believed to be normally loaded. Bedrock occurs beneath the southern half. The center of the Skyway crosses the Burlington Channel from Hamilton harbour into Lake Ontario. Beam spans are in units of three or four spans to allow for differential settlements. Results of settlement readings are presented as a case history, along with a number of unusual features in the foundation subsoil due to its origin. — *from* Authors' abstract

Matsch, Charles L. *See* Rapp, George R., Jr. 01290

Matson, N. A., Jr. *See* Richter, D. H. 01342

Mattick, R. E. *See* Granger, H. C. 01390

01322 **Mazzullo, S. J.** Length of the year during the Silurian and Devonian Periods — New values: Geol. Soc. America Bull., v. 82, no. 4, p. 1085-1086, table, 1971.

Daily growth increments and monthly markings on corals and brachiopods indicate the number of days per year was 421 in Early Silurian, 419 in Middle Silurian, and 410 in early Middle Devonian. The number of days per month decreases from 32.4 in Early Silurian to 31.5 in early Middle Devonian. — AG

08689 **McAllister, James F.** Geology of the Furnace Creek borate area, Death Valley, Inyo County, California: California Div. Mines and Geology Map Sheet 14, 9 p., table, text, 1970.

Precambrian and Paleozoic rocks of the Funeral Mts. extend, on the northeastern margin, to the foot of the mountains where light-colored Tertiary rocks of the Furnace Creek Formation are faulted against the darker Paleozoic, and capped to the east by dark volcanic flows of the Funeral Formation. The Furnace Creek Formation is gently folded and tilted steeply along faults. In the Tertiary Artist Drive Formation, sedimentary rocks interfinger with or change into volcanic rocks and other sedimen-

tary rocks. In the Furnace Creek Formation, principal borate deposits are in continental rocks near the base of the formation. Smaller deposits are in basaltic rocks and gypsiferous beds higher in the formation. Boron minerals in the Furnace Creek area are tabulated with their compositions. — ESL

08612 **McCammon, Richard B.** Component estimation under uncertainty, *in* Geostatistics — A colloquium (D. F. Merriam, editor), Lawrence, Kan., 1970, Proc.: New York, Plenum Press, p. 45-61, illus., 1970.

A procedure is outlined for estimating unknown proportions of mixtures of mineralogic components in porous sedimentary rocks in situations where the number of components exceeds the number of measured rock properties on which estimates are to be based. A probabilistic approach is proposed in which a prior probability distribution is imposed on values taken on by the set of components and optimal estimates are obtained by maximizing the conditional probability defined for those values which are consistent with the given information. The introduction of prior probability distributions to the problem of component estimation under uncertainty offers a new direction in formation evaluation. — Author's abstract

01289 **McCullough, Edgar J.** Geology by television, *in* Teaching introductory college geology by television — Council on Education in the Geol. Sci. Pub. 6: Washington, D.C., Amer. Geol. Inst., p. 2-24, tables, 1971.

This article discusses the use of television, since 1962, in teaching a course in elementary geology at the University of Arizona and includes the organization of the course, attendance figures, and student and faculty response. The author feels that television is probably the most effective method of presenting information to a learner and that it is preferable to lectures, radio broadcasts or textbook assignments. Terminal performances of the students, which are the objectives of the course, are outlined, as well as the instructional objectives to be used in obtaining these performances. The title outline of the course, sample lesson outline, laboratory exercises, semester final exam, evaluation, and other aspects of the course are included in appendices. — EH

08628 **McGlynn, J. C.; Henderson, J. B.** Archean volcanism and sedimentation in the Slave Structural Province, *in* Basins and geosynclines of the Canadian Shield (A. J. Baer, editor) — Symposium, Ottawa, 1970, Papers: Canada Geol. Survey Paper 70-40, p. 31-44, illus., table, 1970.

Archean volcanic and sedimentary rocks of the Yellowknife Supergroup in the Slave Province occur in discontinuous northerly trending belts separated by large areas underlain by granitic rocks. Volcanic sequences in part bordering these belts consist of mafic lavas with both calc-alkali and tholeiitic differentiation trends and are commonly capped by more silicic volcanic and pyroclastic rocks. The central parts of the belts are filled with sediments interpreted as turbidites. The Yellowknife rocks probably were deposited on a continuous, highly mobile sialic crust. The mafic volcanics were extruded from linear fractures paralleling contacts between positive and negative areas. Sediment derived from the positive sialic areas was poured into the intervening negative basin areas. Extensive deformation and diapiric granitic intrusion at the basin margins resulted in the situation seen today. — DBV

McGlynn, J. C. *See* Hoffman, P. F. 08632

McGowen, J. H. *See* Fisher, W. L. 08570

McIlroy, Paul. *See* Granger, H. C. 01390

McKay, E. J. *See* Granger, H. C. 01390

08530 **McKee, Bates; McKee, Pamela.** Refractive index data for fused glass from basalt of the Columbia Plateau, *in* Columbia River Basalt Symposium, 2nd, Cheney, Wash., 1969, Proc.: Cheney, Eastern Washington State College Press, p. 39-49, illus., 1970.

Powdered basalt samples (93) from the Columbia River basalts and Ellensburg Formation were fused in a carbon arc and the refractive index of the resultant glass beads determined by standard techniques. Yakima Basalt flows from beneath the Vantage Sandstone had indexes lower than all samples above this member. Picture Gorge Basalt gave intermediate values, and flows within the Ellensburg were in approximately the same range as late Yakima samples. Individual members cannot be identified as yet by this method because of considerable compositional variation within single flows. The refractive index correlates with Si and Fe content; the best correlation was obtained by plotting indexes against Fe/Si ratios rather than against Si alone. Even then, the scatter indicates important compositional controls on the refractive index. — DBV

McKee, Pamela. *See* McKee, Bates. 08530

01107 **McKenna, Malcolm C.** A route to Late Cenozoic temperature history [Discussion of "Marine sediments — Dating by racemization of amino acids," by J. L. Bada; B. P. Luyendyk; J. B. Maynard, 1970]: Science, v. 172, no. 3982, p. 503, 1971.

The paper under discussion was published in Science, v. 170, no. 3959, p. 730-732, 1970 (see Abs. North American Geology, April 1971).

08464 **McKenzie, Garry D.** Glacial geology of Adams Inlet, southeastern Alaska: Ohio State Univ. Inst. Polar Studies Rept. no. 25, 121 p., illus., tables, 1970.

Rapid deglaciation of the area of Adams Inlet in the Chilkat-Baranof Mts., eastern Glacier Bay National Monument, Alaska, in the first half of the 20th century exposed thick sections of surficial deposits, from oldest to youngest: Granite Canyon Till and Forest Creek Formation, C-14 age prior to 10,000 yr B. P.; and lower member of the Van Horn Formation, and the Adams, Berg, Glacier Bay, and Sea River Formations, C-14 age 4000 B. P. to present. The sequence of events following deposition of the late Wisconsin Granite Canyon Till is outlined; no deposits are present in Adams Inlet dated between about 10,000 and 4,000 yr B.P. Buried ice is still present in parts of Adams Inlet and ice-contact deposits such as eskers, kames, and pitted outwash are common. Outwash deltas are rapidly building into the inlet. — VSN

McLachlan, J. *See* Illiman, W. I. 08686

08579 **McMahon, Clifford C.** Particle size analysis by the method of Musgrave and Harner: Am. Ceramic. Soc. Bull., v. 49, no. 9, p. 794-796, illus., 1970.

A simple theory of the turbidimetric method of particle size measurement is discussed with special reference to the work of Musgrave and Harner, whose calculations are corrected and simplified, making the method even more suitable for quality control work. — Author's abstract

McManus, Dean A. *See* Kelley, James C. 08553

01253 **McRitchie, W. D.** Preliminary geological investigations of the Nelson House-Pukatawagan region, Manitoba (Burntwood Project): Manitoba Dept. Mines and Nat. Resources Mines Br. Geol. Paper 2/71, 16 p., illus., table, geol. maps, 1971.

As a result of this short study, a geological mapping program proposed for 1971, between Wuskwatim Lake and the Saskatchewan border, will include economic evaluation, and details on the structural and metamorphic setting. Lake Agassiz clays and poorly sorted till, increasing from west to east, cover glaciated bedrock, an aeromagnetic plateau with little variation. Isolated magnetic highs correspond to various granitic intrusions; westerly-trending metasedimentary gneisses are flanked north and south by metavolcanics. Ten Precambrian units are described briefly; distribution is shown on four reconnaissance map-sheets. Mineralization, commonly associated with hornblende-rich paragneisses, appears to be dependent on original composition of host rocks. Brief summary of structure and metamorphism suggests four stages of deformation. — GDC

08522 **Medina R., Flavio.** El drenaje subterráneo en la región de Aristo-San Lorenzo, Mpio. de Villa Hidalgo, S.L.P. [Subterranean drainage in the Aristo-San Lorenzo area, Municipio of Villa Hidalgo, San Luis Potosí]: Geología y Metalurgia, v. 5, no. 32, p. 5-27, illus., tables, 1970.

A hydrogeological study was made in the central part of the deep Aristo Valley to determine the amount of underground leakage of the valley's drainage. The area, about 50 km northeast of San Luis Potosi is about 1,000 km² and has an average altitude of 1,500 m. To define the drainage, data from open wells and recent drillholes were used. From the geochemistry of the water it was possible to delineate the underground leakage which flows from west to east, draining toward the most eastern part of Villa Hidalgo and transporting water of good quality. This study will be of value in helping to locate new borings in the study area. — *from* Author's abstract

01181 **Mello, James F.** Foraminifera from the Pierre Shale (Upper Cretaceous) at Red Bird, Wyoming: U.S. Geol. Survey Prof. Paper 393-C, 54 p., illus., tables, 1971.

Foraminifera were recovered from 75 samples taken from the complete section of Pierre Shale exposed at Red Bird, Wyo. Arenaceous Foraminifera are dominant in most samples, but some samples contained calcareous benthonic and planktonic specimens, and many yielded internal molds of presumably calcareous species. Patterns of distribution of taxa show no convincing relation with regional depositional history, macrofossil occurrences, or Holocene distributional patterns. Most foraminiferal species are rare and occur sporadically, and most of the rest are long ranging, either locally or regionally. No biostratigraphic subdivisions are proposed. Of 61 identified taxa, 46 are assigned positively or provisionally to previously named species, one species is described as new, and 14 taxa bear informal species nomenclature. Species *Haplophragmoides excavata* Cushman and Waters is emended to include five morphologic subgroups. — *from* Author's abstract

08503 **Mello, James F.** Paleontologic data storage and retrieval, *in* Computers in paleontology — North Am. Paleont. Convention, Chicago, Ill., 1969, Proc., Pt. B: Lawrence, Kans., Allen Press, p. 57-71, illus., 1970.

This paper outlines the types of problems which paleontologic data present to those who wish to use computers in their manipulation. There are two funadmental ways in which the computer can be useful in storage and retrieval of paleontologic data. It can perform tedious or time-consuming tasks more efficiently, such as literature searching; and, more important, it provides the potential for much freer analysis of individual variables which at present are treated collectively. The computer will provide the means for a critical analysis of the structure of much paleontologic data, leading to strengthening of some procedures, abandonment of others, and establishment of new levels of relationship between and among fossils which cannot be discerned at present. — DBV

Mendive A., Lázaro. *See* DelCastillo G., Luis. 08452

08608 **Merriam, Daniel F.** (editor). Geostatistics — A colloquium, Lawrence, Kan., 1970, Proc.: New York, Plenum Press, 177 p., illus., tables, 1970.

This volume records the proceedings (12 papers) of a colloquium in which statisticians with interests in applications in the earth sciences met with earth scientists interested in applying statistics to problems. The colloquium was held June 7-9, 1970, the eighth in a series on "Computer Applications in the Earth Sciences." The stated purpose of the meeting was to explore some assumptions, limitations, and applications for statistical geology and geostatistics. Participants represented 11 countries including the United States (20 states), with about 44 percent from academia, 40 percent from industry, and 16 percent from governmental agencies. — DBV

01060 **Merrill, Harvey B., Jr.** A new technique for the preparation of samples for microscopic examination [abs.]: Georgia Acad. Sci. Bull., v. 29, no. 2, p. 126, 1971.

08688 **Michigan Basin Geol. Society.** Guidebook for field trips in connection with Geol. Soc. America North-Central Sec. meeting, May 1970: [East Lansing, Mich.], Michigan Basin Geol. Soc., 177 p., illus., tables, 1970.

A compilation of background information is presented with road logs for three field trips: Devonian strata of Alpena and Presque Isle Counties, Michigan, by G. M. Ehlers and R. V. Kesling; Glacial history of the Glacial Grand Valley, by D. F. Eschman and W. R. Farrand; and Precambrian of the Marquette area, Michigan, by H. B. Stonehouse (Field trip chairman). These are separately cited. — GDC

08574 **Mifflin, M. D.** Mudlumps and suggested genesis in Pyramid Lake, Nevada [with French abs.], *in* Symposium on the Hydrology of Deltas, V. 1: Internat. Assoc. Sci. Hydrology-Unesco Pub. 90, p. 75-88, illus., 1970.

In 1967 mudlumps similar to those of the Mississippi River delta formed in Pyramid Lake adjacent to a rapidly growing Truckee River delta. Antecedent conditions of stream flow, lake level, and delta growth are known; structure, distribution, and timing of the mudlumps indicate a direct relation to rapid growth of the delta on offshore muds. A mechanism of formation is suggested that calls upon greatly increased pore-water pressure in prodelta lacustrine deposits generated by rapid delta growth and associated rapid loading. Strain culminates as upthrust elongate blocks of mud in the prodelta area when the pore-water pressure exceeds the downward acting overburden pressure. The process requires a number of environmental factors not commonly localized in nature; the rare occurrence of mudlumps may relate to absence of one or more of the necessary environmental conditions in most deltas. — *from* Author's abstract

01009 **Miller, Don J.; Plafker, George.** Geologic map of the Yakataga District, Gulf of Alaska Tertiary province, Alaska: U.S. Geol. Survey Misc. Geol. Inv. Map I-610, scale 1:125,000, sections, separate text, 1971.

The petrology and relations of a crystalline complex and lava flows along the north, and the Yakutat Group are considered. A depositional contact between the Yakutat and overlying sedimentary rocks of Tertiary age is tentatively mapped from airphotos near the east end of Waxell Ridge. The Eocene-Pliocene Kulthieth, Poul Creek, and Yakataga Formations in the Robinson Mts. exceed 25,000 feet in thickness; fossils from these are tabulated. Major intraformational unconformities occur. Oil seeps have been found, and coal occurs in some outcrops. Some gold placers have been mined. — ESL

01106 **Miller, E. Willard.** The mineral fuels, Chap. 16 *in* Conservation of Natural Resources (Guy-Harold Smith, editor): New York, John Wiley and Sons, p. 401-448, illus., tables, 1971.

Reviewed are source areas in the United States, and increasing production of coal, petroleum, shale oil, natural gas, and nuclear energy; also conservation problems, exploration development, technical advances. Still abundant, mineral fuels are irreplaceable and limited in quantity. Coal will retain its lead as the nation's fuel, with economies and efficiencies in utilization; its use for steam generation is encouraged, but coking coals should be reserved for metallurgical uses. Petroleum will be depleted relatively soon; its use should be reserved for motor fuels and lubricating needs; eventual use of shale and synthetic oils may be considerably more costly. Natural gas should be reserved for domestic and specialized industrial uses. The change to atomic energy will be gradual, supplementing rather than displacing mineral fuels. — GDC

01280 **Miller, F. P.; Holowaychuk, N.; Wilding, L. P.** Canfield silt loam, a Fragiudalf — [Pt.] I, Macromorphological, physical, and chemical propertes: Soil Sci. Soc. America Proc., v. 35, no. 2, p. 319-324, illus., table, 1971.

Eighteen Canfield profiles derived from dolomitic glacial till were described and characterized as Aquic Fragiudalfs according to the current USDA comprehensive classification system. The high bulk density (1.7) of the fragipan and very low

hydraulic conductivity results in lateral movement of percolating water across the fragipan surface equivalent to about 30 percent of the total precipitation. — Soil brief

01281 **Miller, F. P.; Wilding, L. P.; Holowaychuk, N.** Canfield silt loam, a Fragiudalf — [Pt.] 2, Micromorphology, physical and chemical properties: Soil Sci. Soc. America Proc., v. 35, no. 2, p. 324-331, illus., table, 1971.

Cutan and matrix samples were separated from several fragipan horizons and analyses of these isolates were compared with each other and the bulk horizon samples. Cutan samples contained more clay, proportionally higher quantities of exchangeable cations, and more 17A and 14A minerals in the clay fraction than either bulk or matrix materials. Micromorphology verified the orientation of the cutan clay and confirmed the presence of an argillic horizon above the fragipan. — Soil brief

Milne, V. G. *See* Ayres, L. D. 01111

01315 **Misra, S. B.** Stratigraphy and depositional history of Late Precambrian coelenterate-bearing rocks, southeastern Newfoundland: Geol. Soc. America Bull., v. 82, no. 4, p. 979-988, illus., table, geol. map, 1971.

Fossils of soft-bodied coelenterates, as well as Medusae, occur in the upper part of the Cape Cover Formation, which is composed of cyclic beds — deposited by turbidity currents — that grade from graywacke to argillite. The Cape Cove Formation, along with the underlying Freshwater Point and Drook formations compose the Conception Group, 7000 feet of graywacke, siltstone, argillite, and banded cherts (in the Drook); the Group is overlain by 1100 feet of the St. John's Formation. During late Precambrian time deposition of the Conception Group began in isolated basins that subsequently joined to form a shallow marine environment, that had deepened sufficiently by Cape Cove time to support turbidity currents. — RGY

01293 **Mitchell, B. J.; Landisman, M.** Electrical and seismic properties of the Earth's crust in the southwestern Great Plains of the U.S.A.: Geophysics, v. 36, no. 2, p. 363-381, illus., table, 1971.

Data from 20 magnetotelluric stations were used to determine a resistivity-depth distribution for the crust in western Texas. The derived model includes an anisotropic, low resistivity layer at depths slightly greater than 20 km. The resistivity model is compared with a seismic velocity interpretation for eastern New Mexico, and the low resistivity layer is inferred to coincide with a low-velocity zone, whose base occurs at the transition from intermediate to more basic rocks in the crust. The low resistivity values are interpreted as resulting from interstitial fluid, which may cause low seismic velocities and may form a weak region in which continental earthquakes occur. Interstitial water at depth in the crust may be produced by intersection of crustal temperature-depth curve and equilibrium boundaries of hydrothermal reactions. — *from* Authors' abstract

01217 **Mitchell, R. J.; Burn, K. N.** Electronic measurement of changes in the volume of pore water during testing of soil samples [with French abs.]: Canadian Geotech. Jour., v. 8, no. 2, p. 341-345, illus., table, 1971.

Two systems are described for electronic recording of changes in the volume of pore water for triaxial testing of soils: one using a miniature force transducer to measure by direct weighing; the other based upon a float system connected to the core of a differential transformer. Both systems provide measurement of volume change at least as accurately as may be obtained by visual reading of burettes graduated to 0.1 cm^3, i.e. to ± 0.05 cm^3. — Authors' abstract

01308 **Mohan Rao, U.** Comments on 'Flume studies of the sediment transfer coefficient' by Neil Coleman [1970]: Water Resources Research, v. 7, no. 3, p. 747-750, illus., table, 1971.

For the paper under discussion, *see* ibid., v. 6, no. 3, p. 801-809, 1970; Abs. North American Geology, February 1971.

01327 **Molnar, Peter; Sykes, Lynn R.** Plate tectonics in the Hispaniola area — Discussion [of paper by D. R. Bracey and P. R. Vogt, 1970]: Geol. Soc. America Bull., v. 82, no. 4, p. 1123-1126, illus., 1971.

For the paper under discussion, *see* ibid., v. 81, no. 9, p. 2855-2859, 1970; Abs. North American Geology, May 1971.

08631 **Money, P. L.; Baer, A. J.; Scott, B. P.; Wallis, R. H.** The Wollaston Lake Belt, Saskatchewan, Manitoba, Northwest Territories, *in* Basins and geosynclines of the Canadian Shield (A. J. Baer, editor) — Symposium, Ottawa, 1970, Papers: Canada Geol. Survey Paper 70-40, p. 170-197, illus., tables, discussion, p. 197-200, 1970.

The Wollaston Lake Belt, consisting mainly of supracrustal rocks, is at least 400 mi long and up to 50 mi wide, is generally bounded by plutonic rocks, and appears to be underlain everywhere by Archean sialic basement. The Aphebian rocks of the belt are divisible into the Daly Lake Group (meta-arkose and biotite gneiss), Hidden Bay assemblage (marble and calc-silicate rocks), Sandfly Lake Group (like the Daly Lake plus hornblende-biotite gneiss, amphibolite, and "acidic metavolcanic rocks"), and Meyers Lake Group (quartz-pebble metaconglomerate, quartzite, pelitic schist). The Sandfly Lake Group is probably the oldest; the Meyers Lake Group overlies it, probably unconformably; the Daly Lake Group was probably deposited conformably on the Meyers Lake to the east and unconformably on the Archean basement to the west; and the Hidden Lake assemblage appears to correlate with the Daly Lake Group. — DBV

08580 **Monkhouse, F. J.** Principles of physical geography [7th edition, revised]: New York, American Elsevier Publishing Company, 570 p., illus., table, 1970; originally published by University of London Press, 1954.

This edition is a major revision involving a re-setting of the type and repagination of the book; addition or replacement of material in the light of recent concepts in geomorphological, geophysical, and meteorological research; and a number of new or modified diagrams. There are 22 chapters including materials of the Earth's crust, the structure of the Earth, vulcanicity, sculpturing of the surface, underground water, rivers and river systems, lakes, glaciation, desert lands, coastlines, classification of landforms, configuration of oceans and seas, waters of the oceans, climatic features, the soil, vegetation, and a conclusion. — GDC

08549 **Moore, Bruce R.; Dennen, William H.** A geochemical trend in silicon-aluminum-iron ratios and the classification of clastic sediments: Jour. Sed. Petrology, v. 40, no. 4, p. 1147-1152, illus., 1970.

Plots of the principal elements Si, Al, Fe for normal clastic sediments reveal a very definite geochemical trend for these elements. Al/Fe ratios lie between 1.5 and 2.5 while Si is continuously variable but has clearly distinguishable ranges for each of the currently used sediment types when plotted on a Si-Al-Fe ternary diagram. Igneous rocks undergoing weathering tend to move in composition toward the Si, Al, Fe "main sequence" and later separate by hydraulic sorting toward either the coarser quartzose sandstone or finer shale ends of this sequence. The results indicate the possibility of clarification of existing classifications and of determining the parent-rock types of certain metasediments. — Authors' abstract

Moore, H. J., 2d. *See* Hinrichs, E. N. 01007

Moore, H. J., 2d. *See* Hinrichs, E. N. 01008

01010 **Moore, James G.** Bathymetry and geology — East cape of the Island of Hawaii: U.S. Geol. Survey Misc. Geol. Inv. Map I-677, scale 1:62,500, text, 1971.

08561 **Moore, James G.** Submarine basalt from the Revillagigedo Islands region, Mexico: Marine Geology, v. 9, no. 5, p. 331-345, illus., tables, 1970.

The dominant exposed rocks of the submarine part of the island-forming volcanoes, in the Revillagigedo region are a uniform alkali pillow basalt; more siliceous rocks are exposed on the upper, subaerial parts of the volcanoes. Tholeiitic pillow basalts are dredged from smaller seamounts to the south on Clarion fracture. Pillows of the alkali basalt are more vesicular than Hawaiian tholeiites from the same depths. Mn-Fe oxide nodules contain nuclei of rhyolitic pumice or basalt pillow fragments; the pumice floated to the site, became waterlogged, and sands sank to be coated with the oxides. The thickness of the palagonite rinds on glassy pillow fragments is proportional to the thickness of the Mn-Fe oxide layers, and both are a measure of the age of the nodule. Both oldest basalts (10-100 m.y.) and the youngest (less than 1 m.y.) are along the Clarion fracture zone, whereas basalts from Roca Partida and San Benedicto volcanoes are of intermediate age. — HRC

01154 **Moore, William J.; Lanphere, Marvin A.** The age of porphyry-type copper mineralization in the Bingham mining district, Utah — A refined estimate: Econ. Geology, v. 66, no. 2, p. 331-334, illus., tables, 1971.

Hydrothermal biotite that crystallized contemporaneously with bornite, chalcopyrite, and molybdenite in the disseminated ore zone at Bingham, Utah, has a potassium-argon age of 3.58 m.y. This and other age measurements indicate that the time difference between plutonism, mineralization, and volcanism at Bingham can be resolved. — Authors' abstract

Moran, S. R. *See* Johnson, W. H. 01234

Morey, G. B. *See* Sims, P. K. 08587

08440 **Moritz, Helmut.** Least-squares estimation in physical geodesy: Ohio State Univ. Dept. Geod. Sci. Rept., no. 130 (U.S. Air Force Cambridge Research Lab., AFCRL-70-0202), 52 p., illus., 1970.

A powerful and simple least-squares estimation method for the gravitational field, developed by T. Krarup [1968-69], is presented and applied to such different problems in physical geodesy as the geodetic boundary-value problem according to A. Bjerhammar, the application of aerial gravimetry, the geodetic use of gradiometer measurements, and the combination of gravimetry with staellite harmonics and with astrogeodetic data. The algorithm is identical to that of the usual least-squares gravity estimation; it is only necessary to interpret the covariances in a different way. The data may be errorless or affected by observation errors. — *from* Author's abstract

01043 **Morse, S. A.; Talley, John H.** Sapphirine reactions in deep-seated granulites near Wilson Lake, central Labrador, Canada: Earth and Planetary Sci. Letters, v. 10, no. 3, p. 325-328, illus., 1971.

Sapphirine and magnetite are closely associated in elongate pods in the granulites of Wilson Lake, central Labrador, where quartz, hypersthene, sillimanite, kyanite, corundum, and spinel also occur in textural equilibrium with sapphirine. Evidence exists for at least five retrograde reactions involving sapphirine, in the absence of cordierite. The metamorphic conditions to be inferred for these rocks are extreme, based on the experimental work of Hensen and Green (1970). Conditions in excess of 11 kbar, 1100°C, and possibly as high as 13 kbar, 1150°C are suggested by the experimental work. — Authors' abstract

Mortland, M. M. *See* Doner, H. E. 01282

Mower, R. W. *See* Arnow, Ted. 08427

Muffler, L. J. P. *See* Griscom, Andrew. 01003

01375 **Mull, D. S.; Cushman, R. V.; Lambert, T. William.** Public and industrial water supplies of Kentucky, 1968-69: Kentucky Geol. Survey, ser. 10, Inf. Circ. 20, 107 p., tables, 1971.

Results are reported of the third detailed inventory of public and industrial water supplies in Kentucky made as a part of the cooperative water program with the U.S. Geological Survey. The report contains an inventory of all public water supplies in the state and of all industrial supplies withdrawing more than 25,000 gpd. Water furnished to steam-electric generating plants and that used for secondary recovery of oil are excluded. Tabulated data give: source and significance of dissolved mineral constituents and physical properties of natural waters and public and industrial water supplies of Kentucky by county and include chemical analyses and source. — VSN

08582 **Mundorff, J. C.** Major thermal springs of Utah: Utah Geol. and Mineralog. Survey Water-Resources Bull. 13, 60 p., illus., tables, 1970.

Nearly all thermal springs in Utah occur in or near fault zones, very few issue from volcanic rocks, but several are close to areas of late Tertiary or Quaternary volcanic rocks, and temperatures of those studied range from 68° to 189° F. Only three springs have recorded temperatures near the boiling point of water and of these, only two (Roosevelt and Abraham Hot Springs) are in a potentially valuable geothermal area. Dissolved-solids in spring waters range from 214 ppm for a spring at 80° F to about 45,000 ppm for a spring at 132° F. Most springs are of sodium chloride type. Silica concentrations exceed 100 ppm for two springs. Springs with low temperatures and dissolved solids and large discharges are valuable sources of water supply. Those adding significant amounts of high dissolved solids to streams and lakes result in deterioration of quality of the surface-water supply. — VSN

01103 **Munn, James K.** Breedlove field, Martin County, Texas: Am. Assoc. Petroleum Geologists Bull., v. 55, no. 3, p. 403-411, illus., 1971.

The Breedlove field in Martin County, Texas, was discovered in 1951 and has produced 17,876,902 bbl of oil from 42 wells in the Silurian and 6 wells in the Permian. The Silurian carbonate section in West Texas, can be subdivided into three stratigraphic units in the Breedlove field: 'upper' Silurian, 'middle' Silurian, and Fusselman. The major producing zone is the 'upper,' which thins northward and eastward over a southwest-plunging anticlinal fold. The 'upper' Silurian is overlain by the Woodford shale and separated from the underlying porous Fusselman reservoir by the nonporous 'middle' Silurian limestone unit. Porosity in the reservoir is from fracturing, selective dolomitization, and pre-Woodford erosion. — *from* Author's abstract

Munroe, Robert J. *See* Sass, J. H. 01084

08701 **Murata, K. J.** A test for chemical equilibrium between olivine phenocrysts and their basaltic host melts, *in* West Commemoration Volume: Faridabad, Indian, University of Saugor, p. 331-336, illus., table, 1970.

The melting relations within the system forsterite-fayalite can be expressed as a single curve by plotting the iron ratio, $(FeO + 0.9Fe_2O_3)/(MgO + FeO + 0.9Fe_2O_3)$, of a given synthetic olivine along the ordinate, and the iron ratio of the melt in equilibrium with this olivine along the abscissa. Such a curve offers a convenient means for determining presence or absence of equilibrium between phenocrystic olivines and groundmass of their host basalts. Hawaiian olivines that were judged from other criteria to have been in equilibrium with the melt have iron ratios that plot within ± 0.03 of the curve. Components of basalt other than total iron oxides and MgO lower equilibrium temperatures but apparently do not alter equilibrium compositions with respect to total iron oxides and MgO. — *from* Author's abstract

01125 **Murthy, V. Rama.** Trace-element studies, *in* Volcanology, Geochemistry and Petrology, U.S. National Report, 1967-1971, Fifteenth General Assembly, IUGG: EOS, v. 52, no. 5, p. IUGG 110-118, 1971.

Trace element research in the U.S. in 1967-71 covered a gamut from the origin of rocks to crust-mantle evolutionary history to cosmological fractionation processes. Two new areas were added to the list, studies of lunar samples and studies related to plate tectonics. This discussion and bibliography does not include lunar sample in-

vestigations, as they are covered in another report, nor does it include references on rare gases, which should be included in the future. The bibliography, believed to cover at least 70 percent of material published in the past four years, is divided under five headings: analytical techniques; alkalis, alkaline earths, uranium, and thorium; rare earth elements; studies related to global tectonics; and other trace-element studies. — DBV

Mutschler, Felix E. *See* Larson, Edwin E. 01346

08430 **Nace, Raymond L.** World hydrology, status and prospects [with French, Spanish, and Russian abs.], *in* Internat. Assoc. Sci. Hydrology-Unesco Pub. 92, p. 1-10, illus., table [1970?].

The broad definition of hydrology used as a guide for the IHD program is accepted, but interpretation of the definition, and of the role of hydrologists in modern problems, must be very liberal, as water cannot be studied independently of other factors. Basic data, essential for water development and research, are deficient for huge areas of the world. "Deficient" and "adequate" are relative terms whose use commonly is subjective. Some deficiencies and inadequacies, such as those for streamflow, are less acute than is commonly supposed. Other data, such as those for dissolved and suspended solids in rivers, are inadequate by any standard for much of the world. Systems simulation, data reduction, analysis and extrapolation make apparent deficiencies in some kinds of data much less serious than they were a decade or two ago. New methods for quickly obtaining synoptic and sequential data for large areas also improve the prospects for world hydrology. — *from* Author's abstract

01204 **Naidu, P. S.** Comments on a paper by Ki-iti Horai and Amos Nur, "Relationship among terrestrial heat flow, thermal conductivity, and geothermal gradient" [1970]: Jour. Geophys. Research, v. 76, no. 14, p. 3426-3427, illus., 1971.

The paper under discussion was published in Jour. Geophys. Research, v. 75, no. 11, p. 1985-1991, 1970 (*see* Abs. North American Geology, November 1970).

Nakahara, R. H. *See* Rosenau, J. C. 01108

08660 **Naldrett, A. J.** Ultramafic and related mafic rocks of the Abitibi orogen [comments on "The Abitibi orogenic belt" by A. M. Goodwin and R. H. Ridler, 1970], *in* Basins and geosynclines of the Canadian Shield (A. J. Baer, editor) — Symposium, Ottawa, 1970, Papers: Canada Geol. Survey Paper 70-40, p. 24-30, illus., 1970.

Ultramafic and related mafic rocks in the Abitibi orogen fall into three broad classes: large igneous complexes, smaller layered intrusions, and lenses of peridotite and pyroxenite. Their occurrences are described briefly. All crystallized at an early stage in the history of the orogen, before much folding had occurred. This indicates that the magmas involved may have had a common origin with those forming the volcanic rocks. The large anorthosite complexes may represent the magma chambers in which the more felsic volcanics were differentiated. — DBV

08461 **Naplin, Charles E.** Ground-water survey of the Buxton area, Traill County, North Dakota: North Dakota Water Comm. North Dakota Ground-Water Studies, no. 71 (SEC Project No. 741), 93 p., illus., tables, 1970.

The ground-water survey of the Buxton area, undertaken to evaluate ground-water potential and to find a dependable supply of water, consisted of a study of existing data, test drilling for new data on subsurface conditions, partial well inventory, installation of observation wells, and chemical analyses of selected water samples. The mantle of glacially derived clay, silt, sand, gravel, and boulders in the area is underlain by several hundred feet of stratified sedimentary rocks (undifferentiated Cretaceous and Ordovician) over Precambrian crystalline basement. The Hillsboro and Belmont aquifers of sand and gravel are potentially favorable areas for groundwater development, although the quality of the water in the Belmont is inferior to that in the Hillsboro. Data on chemical analyses of water, records of well and test holes, and logs of test holes are tabulated. — VSN

Nason, Robert D. *See* Rogers, Thomas H. 01166

Naugler, Frederic P. *See* Rea, David K. 01050

Nauman, J. W. *See* Cory, R. L. 08676

Nease, Felton R. *See* Wolf, Frederick A. 01363

08613 **Nemec, Vaclav.** The law of regular structural pattern — Its applications with special regard to mathematical geology, *in* Geostatistics — A colloquium (D. F. Merriam, editor), Lawrence, Kan., 1970, Proc.: New York, Plenum Press, p. 63-78, illus., tables, 1970.

A simple law of regular structural pattern expresses structure of the earth. A series of orders corresponds to different size units from continents to smallest mineral grains. Principles of equidistance and of halving serve as the methodological basis. The diameter of the earth is an original constant, and an identical formula is valid for the moon if the diameter of that body is used. The formula provides a link to numerous earth and planetary sciences explaining a system of orders useful for research and practical problems. The law of regular structural pattern can be considered where mathematical methods are used. A possible improvement in approaching geological problems is demonstrated. — Author's abstract

08543 **Neuman, Karl R.** Palynology of interflow sediments from the Standard Oil Company of California Rattlesnake Hills No. 1 well, Benton County, Washington, *in* Columbia River Basalt Symposium, 2nd, Cheney, Wash., 1969, Proc.: Cheney, Eastern Washington State College Press, p. 201-207, illus., 1970.

Interflow coal and brown shale cuttings, recovered from the 2,100-4,800 foot interval in Rattlesnake Hills No. 1 well, yielded abundant pollen and spores and some freshwater algae. The assemblages are interpreted as post-Eocene or early Oligocene "subtropical" and pre-early or middle Miocene "warm temperate." The suggested age of the interval is middle Oligocene to late Oligocene or early Miocene, thus implying ages of Oligocene to Eocene for older flows in the bottom half of the well. — DBV

01218 **Neuman, Shlomo P.; Witherspoon, Paul A.** Analysis of nonsteady flow with a free surface using the finite element method: Water Resources Research, v. 7, no. 3, p. 611-623, illus., 1971.

A new iterative, numerical approach to nonsteady flow of ground water with a free surface using the finite element method has been developed. The method is unconditionally stable, requires only a small number of time steps to reach the steady state, and can handle problems in which the free surface is discontinuous and portions of the free surface are vertical or nearly vertical. Infiltration or evapotranspiration at the free surface is handled with ease, and effect of the unsaturated zone can be taken into account indirectly by using the concept of delayed yield from storage, as well as storage due to elastic properties of the saturated porous medium. Storage in a well and distribution of velocities along the bore can be taken into account. The method can be applied to a variety of problems involving complex boundaries and arbitrary degrees of heterogeneity and anisotropy. — *from* Authors' abstract

01151 **Neuschel, Sherman K.; Bunker, Carl M.; Bush, Charles A.** Correlation of uranium, thorium, and potassium with aeroradioactivity in the Berea area, Virginia: Econ. Geology, v. 66, no. 2, p. 302-308, illus., table, 1971.

A small quartz monzonite pluton intrudes chlorite-actinolite schist and is overlain by Coastal Plain deposits. A detailed aeroradioactivity survey of the area shows unusually high radioactivity (1,150 counts per second) over the quartz monzonite. In 22 auger samples taken across all formations to 2 to 3 feet, radioelement concentrations were determined by gamma-ray spectroscopy. There is a general direct correlation of high radioactivity with high radioelement concentrations. Abundances of U and particularly Th in the quartz monzonite are two to three times the average for rocks of this type. — *from* Authors' abstract

08646 **New Mexico Geol. Soc.; Woodward, Lee A.** (editor). Guidebook of the Tyrone-Big Hatchet Mountains-Florida Mountains region — New Mexico Geol. Soc. Field Conf., 21st, 1970: Socorro, N. Mex., New Mexico Bur. Mines and Mineral Resources, 162 p., illus., tables, 1970.

This guidebook includes two memorials, 15 articles, 2 abstracts (all cited separately), a stratigraphic nomenclature chart, and 13 abstracts (not cited separately) of technical papers given at the 24th annual meeting of the New Mexico Geol. Soc., Albuquerque, N. Mex., April 1970. The first day's trip is concerned with ore deposits and shelf strata; the second day, with basinal stratigraphy, the fold belt, and basin-range structure; and the third day with a lower Paleozoic section and imbricate thrust slices in the Florida Mts. — ESL

08540 **Newcomb, R. C.** The Columbia River group — Its tectonic structure in Washington, Oregon, and Idaho, *in* Columbia River Basalt Symposium, 2nd, Cheney, Wash., 1969, Proc.: Cheney, Eastern Washington State College Press, p. 173-175, 1970.

A map has been compiled to show areas in which the geologic structure favors accumulation and storage of ground water in the Columbia River Basalt. Included are most of the known folds of more than 100 feet amplitude and faults with more than 50 feet of displacement. The structures displacing the basalt are Pliocene and Quaternary in age, though some, notably the Blue Mountain anticline, were in part pre-basalt highs. Most of the anticlines are tectonic and most of the synclines are valleys. — DBV

Newell, Marcia F. *See* Stern, Thomas W. 01392

01081 **Niazi, Mansour.** Seismic dissipation in deep seismic zones from the spectral ratio of pP/P: Jour. Geophys. Research, v. 76, no. 14, p. 3337-3343, illus., tables, 1971.

The spectral amplitude ratio of phases pP and P is influenced by source conditions and crust-upper mantle structure near the source and at the recording station. The effect at the recording station is expected to be small because of nearly identical response of the recording instrument and its substructure to phases incident below the crust at similar angles. Spectral ratios of pP/P for 48 earthquakes with focal depths ranging between 100 and 700 km are computed. Corrections for effect of geometric spreading and reflection in the outer shell above the focus are applied. The apparent mean Q values for dilatational waves in deep seismic zones of the upper mantle are computed from slope of the adjusted spectral ratios. A minimum is indicated in intrinsic Q near a depth at 200 km. Data of three South American earthquakes with focal depths between 120 and 200 km result in unacceptable negative values for (Q); possible causes of anomalies are discussed. — *from* Author's abstract

Nichols, I. K. *See* Smith, J. T. 01261

01249 **Nidd, Eric; Ambrose, J. W.** Computerized solutions for some problems of fold geometry [with French abs.]: Canadian Jour. Earth Sci., v. 8, no. 6, p. 688-693, illus., 1971.

If the form of a fold is conical, important elements of its geometry are the attitude of its axis and degree of conicity (size of semi-apical angle of cone; if the fold is cylindrical, this angle is 0°, but as the semi-apical angle increases to 90° as a limit, the cone approaches a plane). These elements of a conical fold can be calculated, given the attitudes of a number of planes tangential to the fold surface. Also the standard deviation of the observations from the ideal can be calculated and used to test the structural homogeneity of a given area. — *from* Authors' abstract

Nielsen, D. R. *See* Cassel, D. K. 01224

Nielsen, D. R. *See* Erh, K. T. 01272

08682 **Nielsen, Richard L.** Mineralization and alteration in calcareous rocks near the Santa Rita stock, New Mexico, *in* Guidebook of the Tyrone-Big Hatchet Mountains-

Florida Mountains region — New Mexico Geol. Soc. Field Conf., 21st, 1970: Socorro, N. Mex., New Mexico Bur. Mines and Mineral Resources, p. 133-139, illus., tables, 1970.

Highly altered, mineralized limestones and shales form a zoned halo about the Chino porphyry copper deposit at Santa Rita. Production has come largely from disseminated supergene chalcocite ores in the granodiorite stock, dioritic sills, and Upper Cretaceous shales. Increasingly important are primary chalcopyrite-pyrite tactite ores from the altered Pennsylvanian formations extending eastward. Implied generalizations on mineral zoning and paragenesis of contact metasomatic replacement deposits and on porphyry copper mineralization are discussed. Formation of mineralized tactites and hornfels in calcareous walls was contemporaneous with alteration and mineralization of igneous rocks. Difficult to distinguish in the stock are primary igneous effects and overlapping postmagmatic hydrothermal alteration, and in calcareous wall rocks, thermal metamorphism and the hydrothermal metasomatic replacement effects. — GDC

08448 **Nigrini, Catherine.** Radiolarian assemblages in the North Pacific and their application to a study of Quaternary sediments in core V20-130 *in* Geological Investigations of the North Pacific (James D. Hays, editor): Geol. Soc. America Mem. 126, p. 139-183, illus., tables, 1970.

Distributions of 37 species of Radiolaria are determined from 83 samples of Holocene North Pacific sediments. Recurrent group analysis of these distributions allows recognition of six assemblages which reflect present-day surface water circulation and distribution of upper water masses. Relative abundances of "cold" transitional, and "warm" water recurrent groups in Pleistocene core V20-130 (35°59′ N., 152°36′ E.) determine a radiolarian temperature curve which is similar to a previously determined diatom temperature curve. Two temperature maxima and three temperature minima are recognized in the core. One new species is described. — Author's abstract

01074 **Nilsson, C. S.; Wright, F. W.** Detection of micrometeoroid flux on satellites: Jour. Geophys. Research, v. 76, no. 14, p. 3424-3425, tables, 1971.

This letter presents complete results of experiments designed to measure micrometeoroid flux on Ogo satellites. In about 4,300 hours of available data, 282 events were observed. No events triggered all three sensors in any detector in a realistic manner that did not also trigger a control signal. This is interpreted to mean that no particles of mass greater than about 10^{-12} gram and capable of penetrating about 4,000 A of Al without gross loss of energy impacted on an effective area of 4.9 sq cm ster during an exposure of 4,300 hours. An upper limit of 2×10^{-3} particles per sq m per sec 2π ster can be assigned to the flux on the basis of two events in this time. — DBV

Ninkovich, Dragoslav. *See* Hays, James D. 08450

Noble, D. C. *See* Korringa, M. K. 01039

01031 **Nordin, Carl F., Jr.** Erosion and sedimentation, *in* U.S. National Report, 1967-1971, Fifteenth General Assembly, IUGG, — Oceanography: EOS, v. 52, no. 6, p. IUGG 292-295, 1971.

This review presents a cross-section of activity in the fields of erosion and sedimentation in laboratory studies of transport processes; field studies of transport processes and channel morphology; similitude criteria, transport relations, and flow resistance; deterministic and stochastic models, erosional processes and sediment yield; sedimentary structures; and instrumentation. — DBV

Nur, Amos. *See* Horai, Ki-iti. 01205

Oberlander, T. M. *See* Beaumont, P. 01348

08454 **O'Brien, Neal R.** The fabric of shale — An electron-microscope study: Sedimentology, v. 15, nos. 3-4, p. 229-246, illus., table, 1970.

Scanning and transmission electron micrographs of various shales establish the close correlation between clay-flake orientation and fissility. The shales with the best fissility have the highest degree of preferred orientation. Randomness of clay flakes prevails in non-fissle claystones. The results suggest that the fabric of shales may result either from the deposition of dispersed clay or by the collapse of clay floccules after deposition. — Author's summary

01380 **O'Brien, P. N. S.; Lucas, A. L.** Velocity dispersion of seismic waves: Geophys. Prosp., v. 19, no. 1, p. 1-26, illus., tables, 1971.

This paper reports on a statistical analysis of the velocity differences resulting from calibration surveys and Borehole Compensated Sonic logs from four separate areas, the North Sea, Abu Dhabi, Libya, and Alaska. In no case was the estimated dispersion significantly different from zero. However, mean values did correlate with lithology. For three of the areas, where the calibration surveys were made with a wall-clamp geophone, amplitude measurements were made, and after suitable corrections estimates of the absorption parameter Q were obtained. Q values varied from 20 to 200. If the absorption mechanism is linear and is described by a Q which is independent of frequency, these values would imply dispersion of several percent, but no such dispersion was observed. Possibly the expected dispersion was compensated for by mud filtrate invasion, but more likely the absorption mechanism was nonlinear. — DBV

Offield, T. W. *See* Wilshire, H. G. 01317

Ojakangas, R. W. *See* Sims, P. K. 08587

01023 **Oldale, R. N.; Koteff, Carl; Hartshorn, J. H.** Geologic map of the Orleans quadrangle, Barnstable County, Cape Cod, Massachusetts: U.S. Geol. Survey Geol. Quad. Map GQ-931, scale 1:24,000, sections, text, 1971.

01013 **Olive, Wilds W.** Geologic map of the Blandville quadrangle, Ballard and Carlisle Counties, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-938, scale 1:24,000, sections, texts, 1971.

01016 **Olive, Wilds W.** Geologic map of parts of the Cairo and Barlow quadrangles, Ballard County, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-885, scale 1:24,000, sections, tables, text, 1971.

01300 **Olson, Everett C.** A skeleton of *Lysorophus tricarinatus* (Amphibia:Lepospondyli) from the Hennessey Formation (Permian) of Oklahoma: Jour. Paleontology, v. 45, no. 3, p. 443-449, illus., table, 1971.

A coiled skeleton of the late Early Permian amphibian *Lysorophus tricarinatus* Cope, found near Norman, Okla., provides a basis for a description of morphology and size relationships of different parts of the skeleton, usually known only from incomplete remains of separate individuals. The specimen appears to have been preserved in aestivating position. Its morphology and condition of occurrence suggest close analogy in many aspects of its way of life with the salamander *Amphiuma*. — *from* Author's abstract

08508 **Olson, Everett C.** Current and projected impacts of computers upon concepts and research in paleontology, *in* Computers in paleontology — North Am. Paleont. Convention, Chicago, Ill., 1969, Proc., Pt. B: Lawrence, Kans., Allen Press, p. 135-153, 1970.

Outside of storage and retrieval of information, the uses of computers in paleontological research can be grouped under two headings: (1) morphology and its uses in taxonomy, ontogeny, and evolution, related to treatment of individuals or single taxa as bases for comparison; (2) biostratigraphy, paleoecology, and biogeography, con-

cerned with interrelations within and between complexes comprising multiple taxa and physical parameters and their comparisons in space and time. Use of computers in morphological studies has resulted largely in extensions of what had been initiated before. There is a considerable amount of work based on computer analysis of faunal associations and relations of faunal complexes and inferred environments; the limitations lie in difficulties of preliminary analysis of materials and inadequacies of many parts of the fossil record. Prospects for the future are discussed. — DBV

08578 **O'Neill, James F.; Vallely, James L.** Gold values from the Devils Backbone area, Tallapoosa County, Alabama: Alabama Geol. Survey Circ. 67, 18 p., illus., table, 1970.

From 1830 to date gold production in Tallapoosa County totalled 23,900 oz valued at 668,000 dollars. The most productive mines were the Alabama King, Blue Hill, Gregory Hill, Silver Hill, and possibly Holly prospect. This investigation, made during 1967-68 by the U.S. Bureau of Mines, included outlining the extent of the gold-bearing rock, and sampling of accessible mines, prospects, and outcrops. This indicated that the areas most favorable for prospecting are the mineralized zones, the locations of the Alabama King, and Blue Hill mines, and Holly prospect. — EHS

O'Neill, M. E. *See* Healy, J. H. 01082

Opdyke, Neil. *See* Cox, Allan. 01142

08446 **Opdyke, Neil D.; Foster, John H.** Paleomagnetism of cores from the North Pacific *in* Geological Investigations of the North Pacific (James D. Hays, editor): Geol. Soc. America Mem. 126, p. 83-119, illus., tables, 1970.

A paleomagnetic study has been carried out on 114 piston cores from the Pacific north of lat 20° N. The magnetic stratigraphy was interpreted in terms of the radiometrically derived time scale for the last 4.5 m.y. The large event (in bottom part of Matuyama series) best correlated with the Olduvai or Gilsa event. Average ages of upper and lower boundaries are 1.71 and 1.86 m.y. with deviation exceeding ± 0.1 m.y. The original date of the Olduvai event is 1.91 ± 0.06 m.y. As there is no significant difference between range of event as seen in marine sediments age of Olduvai event and its type locality, it seems proper to correlate this event with the Olduvai. Nine sections were constructed on the basis of magnetic stratigraphy, and rates of sedimentation are calculated using a date of 0.69 m.y. for the Brunhes/Matuyama boundary and compared with sediment distribution in the Pacific. The effect of topography on rates is considered. Rates of sedimentation indicate a Miocene age for time of cessation of turbidite deposition on Aleutian abyssal plain. Rates and sediment distribution favor the hypothesis of mobility of the sea floor. — *from* Authors' abstract

08471 **Orlob, Gerald T.; Shubinski, Robert P.** Water quality modeling of estuaries [with French abs.], *in* Symposium on the hydrology of deltas, V. 2: Internat. Assoc. Sci. Hydrology-Unesco Pub. 91, p. 342-353, illus., 1970.

A set of mathematical models which simulate the hydrodynamic and water quality behavior of a variety of estuaries is presented. The general approach consists of discretizing both embayments and delta areas as a network of elements for which numerical solutions to the equations of continuity, motion, mass transport and dispersion are obtained. Three separate models are discussed: tidal hydrodynamics, dynamic water quality, and steady state water quality. Specific applications to the San Francisco Bay-Delta are shown. Particular emphasis is given to the control of sea-water intrusion in the Delta and to assimilation of wastes in that region. Brief treatment is given to studies of two other estuaries. — *from* Authors' abstract

08431 **Orvig, Svenn.** The hydrological cycle of Greenland and Antarctica [with French, Spanish, and Russian abs.], *in* Symposium on World Water Balance, V. 1: Internat. Assoc. Sci. Hydrology-Unesco Pub. 92, p. 41-49 [1970?].

About 75 percent of all the world's fresh water is stored as glacier ice, most of it in the polar and subpolar regions. If it all melted, sea level would be raised about 70 m. Greenland receives most of its precipitation from middle latitude cyclones; in the Antarctic, cyclonic storms seldom penetrate the continent, except in the west. The net water accumulation of the Greenland icecap is negative at present, about 85 km^3 water/year. The Antarctic budget seems to be positive, with an annual net gain around 600 km^3 water. A relatively stable sea level indicates that the ice caps are in equilibrium. Recently developed physical-mathematical models can be used to examine the energy balance over snow surfaces, and related water budgets. — *from* Author's abstract

08532 **Osawa, Masumi; Goles, Gordon G.** Trace element abundances in Columbia River Basalts, *in* Columbia River Basalt Symposium, 2nd, Cheney, Wash., 1969, Proc.: Cheney, Eastern Washington State College Press, p. 55-71, illus., tables, 1970.

Results of neutron activation analyses for La, Sm, Yb, Lu, Th, U, Co, Fe, Sc, and Cr are presented for Columbia River basalt specimens of known and unknown affinities with the Picture Gorge, Yakima, and Late Yakima varieties. At least two subtypes are distinguished among the Picture Gorge flows, which do not seem to be related simply to common parental magma type. There is a nearly systematic, secular loss of primitive characteristics in rare-earth abundances with decreasing age. Correspondingly, U is less abundant in the older flows than in younger ones. Th/U ratios are generally lower than in most continental rocks. It may be feasible to use trace-element abundances as an aid in categorizing individual flows. An affinity between an intrusive in the Willamette valley and flows at the Picture Gorge type section is suggested. — DBV

Osler, J. C. *See* Yong, R. N. 01298

01158 **Ostenso, Ned A.; Wold, Richard J.** Aeromagnetic survey of the Arctic Ocean — Techniques and interpretations: Marine Geophys. Researches, v. 1, no. 2, p. 178-219, illus., tables, 1971.

Approximately 147,000 km of low-level aeromagnetic tracks were flown over the Arctic Ocean, and Greenland and Norwegian Seas, chiefly with a digitally-recording nuclear precession magnetometer designed and built by Wold (1964). Data processing and analytical techniques used are described. Inferences made on the geologic structure and evolution of the Arctic Ocean basin are included. Magnetic profiles of the Alpha and Nansen Ridges correlate with those of North America. It is inferred that the Alpha Cordillera became inactive 40 m.y. B.P. when rifting shifted to the Nansen Cordillera. The absence of significant magnetic anomalies over the Lomonosov Ridge reinforces the hypothesis that it is a section of the former Eurasian continental margin that was translated into the Arctic Basin by sea-floor spreading along the Nansen Cordillera axis. — *from* Authors' abstract

08514 **Ostrom, John H.** Terrestrial vertebrates as indicators of Mesozoic climates, *in* Paleoclimatology — North Am. Paleont. Convention, Chicago, Ill., 1969, Proc., Pt. D: Lawrence, Kans., Allen Press, p. 347-376, illus., 1970.

At present there appear to be few potential sources of reliable climatic indicators among pre-Cenozoic terrestrial vertebrates. The most promising approach to paleoclimatology using paleontologic data lies in recognition of ancient organic diversity gradients. It has long been recognized that most floras and faunas are more diverse in tropical than at higher latitudes. However, pre-Cenozoic correlatable fossil vertebrate sites are far too few and too widely scattered at present to permit meaningful reconstruction of ancient diversity gradients and their orientations. — DBV

01373 **Ostrom, Meredith E.** Preliminary report on results of physical and chemical tests of Wisconsin silica sandstones: Wisconsin Geol. and Nat. History Survey Inf. Circ. 18, 61 p., illus., tables, 1971.

Wisconsin has vast resources of silica sand in formations of Cambrian and Ordovician age, outcropping in the southern part of the state. The study included 296 size analyses and 90 chemical analyses on samples from 199 locations. Silica sand has been classified based on use as follows: 1) abrasive uses, blasting, glass-grinding, and stone carving; 2) glass and chemical use; 3) refractory uses, core sand, furnace bottom sand, ganister mix, processed molding sand, runner sand; 4) miscellaneous uses, coal-washing sand, filter media sand, hydraulic-fracturing sand, standard-testing sand, and traction sand. Tables include results of grain-size analyses, percent by weight retained on sieves, and chemical analyses. — ESL

01353 **Otvos, Ervin G., Jr.** Relict eolian dunes and the age of the 'Prairie' coastwise terrace, southeastern Louisiana: Geol. Soc. America Bull., v. 82, no. 6, p. 1753-1758, illus., 1971.

Five fluvial source-bordering eolian dune trends consisting of over 70 mounds and hills were recently recognized on the coastwise Prairie terrace surface in the Florida Parishes. Oval plane outlines with dominantly near-parallel long axes characterize the dunes. Maximum dune length is 600 m, with 400 m, and height 10 m. The dune sand is uniformly medium grained, mostly very well sorted and has predominantly near-symmetrical skewnesses; 2 to 13 percent of the 0.25 mm grains are rounded and well rounded. Until now the Prairie and other Pleistocene coastwise terrace deposits along the Gulf of Mexico were generally accepted as interglacial formations. New evidence suggests that the dunes, the Prairie terrace surface, and at least the upper section of the Prairie Formation in the study area, may be of early Wisconsin (glacial) age. — *from* Author's abstract

Overman, R. F. *See* Hawkins, R. H. 01270

08486 **Owens, Willard C.** Ground water and our environment, *in* Governor's Conf. on Environmental Geology: Colorado Geol. Survey Spec. Pub., no. 1, p. 38-41 [1970?].

Without ground water as an auxiliary source of water supply, and without the hydrogeologist to help locate and develop these supplies, our environment could face critical times during surface water shortage or during periods of major surface water contamination. Also, ground water is one of the most common factors in geologic hazards, and often is a major problem on construction and excavation sites. Colorado laws concerning water use are discussed. Numerous problems have arisen within the legally Designated Ground Water Basins, because the preliminary hydrologic investigation relative to the formation of each basin usually has been of a general nature and seldom followed up with detailed studies. The role of the ground-water geologist in the development and management of ground water is becoming more and more significant; the geologist must learn to communicate with the other professions so they can be made aware of this role. — DBV

01066 **Padgett, Edgar Allen, Jr.** The Georgia speleological survey [abs.]: Georgia Acad. Sci. Bull., v. 29, no. 2, p. 129-130, 1971.

01368 **Page, Norman J.** Sulfide minerals in the G and H chromitite zones of the Stillwater Complex, Montana: U.S. Geol. Survey Prof. Paper 694, 20 p., illus., tables, 1971.

Pentlandite, pyrrhotite, chalcopyrite, niccolite, and platinum-group minerals occur in two chromitite zones (G and H) of the Stillwater Complex. Detailed mineralogic studies of stratigraphic sections of both zones illustrate that amount, relative abundance, and size of sulfide minerals are related directly to primary crystallization processes of a fractionating basaltic magma. In the two zones, 2.5 percent sulfide minerals occur as inclusions in cumulus chromite and olivine, 88.4 percent as grains associated with postcumulus phases, and 9.1 percent as fracture fillings and in association with alteration minerals. Inclusions probably represent immiscible sulfide droplets and crystalline sulfide minerals trapped by crystallizing cumulus olivine and chromite, sulfide grains in postcumulus material represent interactions between sulfide droplets and the trapped magma. Temperature, partial pressures of oxygen and sulfur, and growth and settling rates of sulfide and silicate phases were important factors in controlling distribution. — *from* Author's abstract

Pakiser, L. C. *See* Healy, J. H. 01135

Palmer, H. C. *See* Starkey, J. 01269

01041 **Papike, J. J.; Bence, A. E.; Brown, G. E.; Prewitt, C. T.; Wu, C. H.** Apollo 12 clinopyroxenes — Exsolution and epitaxy: Earth and Planetary Sci. Letters, v. 10, no. 3, p. 307-315, illus., tables, 1971.

Clinopyroxenes from [Moon] rocks 12021, 12037, 12053 have been studied by electron microprobe and single crystal X-ray diffraction techniques in order to characterize the crystal-chemical aspects of pyroxene epitaxy and exsolution. The combined chemical and crystallographic data plotted on a Di-Hed-En-Fs data display, based on the unit-cell parameters b and β, suggest a large miscibility gap at low temperature between Ca-rich augite and Ca-poor pigeonites over a large range of Fe/Mg ratios. We also find that in rocks 12021 and 12037 primary pigeonites exsolved augites on both (001) and (100) while primary augites exsolved pigeonite on (001). In rock 12052 the common plane shared by pigeonite cores and epitaxial augite rims is approximately parallel to (100), and little subsolidus exsolution is indicated. — Authors' abstract

Papike, J. J. *See* Bence, A. E. 01114

01122 **Papike, J. J.** Petrologic crystal chemistry, *in* Volcanology, Geochemistry and Petrology, U.S. National Report, 1967-1971, Fifteenth General Assembly, IUGG: EOS, v. 52, no. 5, p. IUGG 82-89, 1971.

This discussion and bibliography points out some of the important areas of activity in petrologic crystal chemistry. Emphasis is on igneous and metamorphic minerals, more specifically on the rock-forming silicates. — DBV

01266 **Parker, Robert L.** The inverse problem of electrical conductivity in the mantle: Royal Astron. Soc. Geophys. Jour., v. 22, no. 2, p. 121-138, illus., table, 1971.

The general method of Backus and Gilbert is applied to the inverse problem of electrical conductivity in the mantle. The data of Banks are reworked to obtain a new model and its uncertainties. It is concluded that the leveling-off in conductivity previously obtained is only barely resolvable with current observations. A great improvement in the accuracy of the model could be expected if more precise data were available in the same frequency range. — Author's summary

Parmele, Leslie H. *See* Engman, Edwin T. 01374

01239 **Parr, B. F.** Pugh Quarry of Ohio — Its geology, minerals and fossils: Earth Sci., v. 24, no. 3, p. 119-123, illus., 1971.

Pugh Quarry, producing crushed rock for construction, is located in western Wood County, and has a wide variety of minerals coupled with excellence of crystal formation. The overburden consists of 15 feet of Wisconsin till; the walls expose three Middle Devonian formations. The main locality for minerals is a horizontal vein, with many vugs and pockets, in the lower part of the Dundee. The locality is best known for its fine scalenohedral calcite, honey- to yellow-brown. Other specimens include barite, celestite, fluorite, dolomite, marcasite, pyrite, and occasionally sphalerite and quartz. A vein of chert, a few feet below the till, contains numerous fossils, the most abundant being charophyte algae oogonia. Smaller fossils are ostracodes, and larger ones include bryozoa, gastropods, a cricoconarid, crinoid stem plates, and brachiopods. — ESL

Patten, Lowell L. *See* Granger, H. C. 01390

Paul, M. J. *See* Sangrey, D. A. 01216

Pawluk, S. *See* Beke, G. J. 01251

Peacor, D. R. *See* Dollase, W. A. 01297

08478 **Pearson, F. J., Jr.; Hanshaw, B. B.** Sources of dissolved carbonate species in groundwater and their effects on carbon-14 dating *in* Isotope hydrology, 1970 — A symposium, Vienna, Austria, 1970, Proc.: Vienna, Austria, Internat. Atomic Energy Agency STI-Pub. 255, p. 271-286, illus., table, 1970.

Sources of dissolved carbonate species in ground-water systems must be known in order to correct C-14 measurements to determine ground-water ages. The initial carbonate comes from soil atmosphere and soil carbonate minerals, that from soil air having values of δ C-13 about 25 percent and C-14 about 100 percent modern. The major source in deeper parts of a ground-water system is solution of carbonate minerals (δ C-13 = 0 percent; C-14 = 0 percent modern) which takes place freely until an equilibrium is approached between dissolved and solid phases. In nearly pure carbonate systems this solution about doubles the content of dissolved carbonate species, and δ C-13 about -12 percent and $C\text{-}14_{true}$ about $2 \times C\text{-}14_{measured}$. Where ionic interaction is affected by silicate dissolution, cation exchange, or mixing of dissimilar waters, dissolved carbonate content increases, and δ C-13 becomes heavier than -12 percent, and $C\text{-}14_{true}$ becomes > twice $C\text{-}14_{measured}$. Non-mineral sources include introduction of heavy CO_2 by thermal solutions or of relatively light CO_2 by oxidation of carbon-bearing substances—*from* Authors' abstract

08534 **Peck, Dallas L.; Wolfe, Jack A.; Griggs, Allan E.** Remarks on the paper "Oregon Cascades in relation to Cenozoic stratigraphy" by H. E. Wheeler and V. S. Mallory [1970], *in* Columbia River Basalt Symposium, 2nd, Cheney, Wash., 1969, Proc.: Cheney, Eastern Washington State College Press, p. 125-130, 1970.

Wheeler and Mallory (ibid., p. 97-124) have presented a theory which is in sharp contrast to the findings of reconnaissance mapping and paleobotanical studies. This paper discusses the basic differences and illustrates by key examples the rationale of the findings of Peck and his colleagues. — DBV

08645 **Peck, Dallas L.** Solidification of ponded basalt flows, as shown by studies of recent Kilauean lava lakes, Hawaii [abs.], *in* Columbia River Basalt Symposium, 2nd, Cheney, Wash., 1969, Proc.: Cheney, Eastern Washington State College Press, p. 328, 1970.

Peng, T.-H. *See* Broecker, W. S. 01036

Percival, Stephen F., Jr. *See* Bukry, David. 01305

01201 **Perkins, P. L.** The dipnoan fish *Dipterus* from the Middle Devonian (Givetian) of Alaska: Jour. Paleontology, v. 45, no. 3, p. 554-555, illus., 1971.

A tooth plate found on the east side of Howard Pass (68°13′ N., 156°50′ W.) is the first dipnoan specimen to be reported from northwestern North America. — FCW

01178 **Perry, E. C., Jr.** Implications for geothermometry of aluminum substitution in quartz from Kings Mountain, North Carolina: Contr. Mineralogy and Petrology, v. 30, no. 2, p. 125-128, illus., table, 1971.

The aluminum concentration of quartz from contact-metamorphosed, Al_2SiO_5 bearing quartzite at King's Mountain, N.C., shows a regular variation with distance from an intrusive contact. Presumably this is the result of temperature-dependent solubility of aluminum in quartz, but critical comparison of these results with other recently published data shows that detailed calibration of this geothermometer has not yet been achieved. — Author's abstract

Persse, Franklin H. *See* Bieniewski, Carl L. 01088

08525 **Peterson, Donald N.** Glaciological investigations on the Casement Glacier, southeast Alaska: Ohio State Univ. Inst. Polar Studies Rept., no 36, 161 p., illus., tables, 1970.

Studies in 1965, 1966, and 1967 of ice motion, thickness, mass-budget, short-term ablation, englacial velocity, and short-term heat balance are reported for Casement

Glacier, northeast of Muir Inlet in Glacier Bay National Monument, southeastern Alaska. Summer velocities were found to be greater than winter and changes in surface velocity corresponded to changes in basal sliding velocity as measured in an ice tunnel. The mass budget of the glacier for the glaciological year 1966-67 was $-235 \pm 46 \times 10^9$ kg. Englacial velocities were measured at each stake established for gravity measurements of ice thickness, and the vertical components of surface velocity, longitudinal thickness profile, and trajectory of a layer of ice were calculated from line 14 through 2, a distance of 14.4 km. The estimated time for this motion is about 140 years. Ice-tunnel investigations were directed toward variations in slip rate and mechanics of basal sliding. — VSN

Peterson, Donald W. *See* Swanson, Donald A. 01377

Peterson, Frank L. *See* Hargis, David R. 08597

01029 **Peterson, M. N. A.** Ocean Sediment Coring Program, *in* U.S. National Report, 1967-1971, Fifteenth General Assembly, IUGG, — Oceanography: EOS, v. 52, no. 6, p. IUGG 256-258, 1971.

The Ocean Sediment Coring Program begun in August 1968 is providing samples of sediments and a small amount of crystalline volcanic or igneous rock from far beneath the floor of the deep ocean basins. The preliminary descriptive work in itself has yielded important scientific discoveries and syntheses: demonstration that the ocean basins are relatively young features for the most part; almost unimpeachable evidence that the sea floor is spreading; discovery of small amounts of oil and gas in salt domes in the central Gulf of Mexico; showing that the floor of the east-central Pacific is migrating slowly beneath the equator of rotation of the Earth; discovery of layers rich in metals in the ocean sediments; establishing that the northwest Pacific must be a remnant of old ocean floor; establishing that the Gulf of Mexico and Mediterranean are underlain by salt; and the first in-place determinations of the average sound velocity vertically in deep-sea sediments. — DBV

Peterson, Norman. *See* Friedman, Irving. 01228

Peterson, S. F. *See* Corey, J. C. 01273

01018 **Peterson, Warren L.; Wigley, Perry B.** Geologic map of part of the Owen quadrangle, Oldham County, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-904, scale 1:24,000, section, 1971.

08679 **Petroleum Resources Section.** Oil and gas exploration, drilling and production summary, 1969: Ontario Dept. Mines and Northern Affairs Paper 70-3, 175 p., illus., tables, 1970.

This volume is divided into four sections and three appendices: part 1 — a brief summary of the organization of the Petroleum Resources Section; part 2 — a statistical summary of exploration, drilling, and production activity for 1969; part 3 — a list of licencees for 1969; and part 4 — geologic and completion data for all wells drilled in 1969. Appendixes include a composite stratigraphic column, cumulative production tables for oil and gas, and a list of available publications and maps. — VSN

08634 **Pettijohn, F. J.** Response [to comments by S. M. Roscoe and M. J. Frarey on "The Canadian Shield — A status report, 1970], *in* Basins and geosynclines of the Canadian Shield (A. J. Baer, editor) — Symposium, Ottawa, 1970, Papers: Canada Geol. Survey Paper 70-40, p. 262-265, 1970.

Pettijohn's remarks on the problems of the Huronian (ibid., p. 239-255) were not intended to detract from or denigrate the work of Frarey and Roscoe (ibid., p. 143-158) nor to challenge the validity of the mapping, but to call attention to some of the still unsolved problems — the sedimentological significance of the McKim and its relationships to the Huronian and Whitewater; the sedimentological history of the great Huronian quartzites; and the Huronian atmosphere. The areas of disagreement and uncertainty are largely the result of lack of knowledge about the rocks themselves. — DBV

08661 **Pettijohn, F. J.** The Canadian Shield — A status report, 1970, *in* Basins and geosynclines of the Canadian Shield (A. J. Baer, editor) — Symposium, Ottawa, 1970, Papers: Canada Geol. Survey Paper 70-40, p. 239-255, tables, 1970.

The Precambrian sedimentary basins of the Canadian Shield display four basic structural styles — the Archean pseudo-eugeosyncline with flysch-like sediments and volcanics; the well-organized Aphebian Proterozoic geosynclines of Alpine affinities; the shallow to deep half-graben structures, mainly Neohelikian continental sediments and lavas, such as the Keweenawan; and the enigmatic mobile belts with a mix of rocks of diverse ages, now high-grade partially granitized metamorphics. The Huronian fits none of these categories. Were it not for the folding and great thickness south of the Murray Fault, it would be considered an intracratonic basin or "autogeosyncline." The question cannot be answered without resolving the problem of the McKim and the Stobie volcanics. — DBV

Pfefferkorn, Hermann W. *See* Gluskoter, Harold J. 08624

01345 **Phair, George; Stern, Thomas W.; Gottfried, David.** Boulder Creek batholith, Colorado — Pt. 3, Fingerprinting discordant zircon ages in a complex intrusion: Geol. Soc. America Bull., v. 82, no. 6, p. 1635-1655, illus., tables, 1971.

The apparent ages of zircon as plotted on an isochron map of the Boulder Creek batholith define a pattern of decreasing ages from south to north. Statistical studies of zircon separates showed that the frequency of grains having rims of colorless zircon on purple to semi-opaque zircon gives a useful estimate of the amount of Pb lost relative to U and Th from a given sample during its recrystallization. The greater part of the rims appears to be true overgrowths, but in any one sample a significant fraction of the zircon remains free of rims. These observations, coupled with map evidence of selective channelway control, point to warm solutions rather than dry heat as the agent of recrystallization and lead loss. — *from* Authors abstract

Phair, George. *See* Stern, Thomas W. 01392

08605 **Pickard, Greenleaf W.** Geology of the Prieta mine, Parral, Chihuahua, *in* AIME world symposium on mining and metallurgy of lead and zinc, St. Louis, Missouri, 1970 [Proc.] — V. 1, Mining and concentrating of lead and zinc: New York, Am. Inst. Mining, Metallurgical, and Petroleum Engineers, p. 123-129, illus., 1970.

The overall dimensions and ore content of the Prieta vein serve to classify it as one of the major lead-zinc mines of the world. Vein extension and width has been governed mainly by the physical character of the wall rock; the important veins fill strong continuous stress-induced fractures in competent andesite. Vertical zoning is well defined. The Pireta orebody is unique; other principal lead-zinc deposits of Mexico are in limestone and other sediments, and veins in andesite elsewhere in Mexico invariably carry gold and silver with very minor base metals and are of limited vertical extent. — DBV

Pierard, Louis H. *See* Gluskoter, Harold J. 08624

Pierce, Kenneth L. *See* Richmond, Gerald M. 01383

01326 **Pike, Richard J.; Wilson, Stephen E.** Elevation-relief ratio, hypsometric integral, and geomorphic area-altitude analysis: Geol. Soc. America Bull., v. 82, no. 4, p. 1079-1083, 1971.

Mathematical proof establishes identity of hypsometric integral and elevation-relief ratio, two quantitative topographic descriptors developed independently of one another for different purposes. Operationally, values of both measures are in excellent agreement for arbitrarily bounded topographic samples, as well as for low-order fluvial watersheds. By using a point-sampling technique rather than planimetry, the elevation-relief ratio (defined as mean elevation minus minimum elevation divided by relief) is calculated manually in about a third of the time required for the hypsometric integral. — *from* Authors' abstract

01288 **Pirkle, William A.** The offset course of the St. Johns River, Florida: Southeastern Geology, v. 13, no. 1, p. 39-59, illus., tables, 1971.

At a point east of Sanford, Florida, the northward-flowing St. Johns River turns toward the west to reach an older valley which it follows northward almost to Palatka before turning east to flow over a younger terrain. The course of the river over the older, more westerly surface is the St. Johns River Offset, which probably marks the course of an ancestral river. Factors in development of the valley include faulting and fracturing, solution of carbonate sediments, and favorable structures for artesian discharge. Preservation of the offset valley as a major stream course is due to discharge of large quantities of artesian water, made possible in the northern part by a relatively permeable aquiclude and in central and southern areas by exposure of the aquifer. Numerous springs from Lake George southward mark sites where the aquifer is exposed or breached. — *from* Author's abstract

01129 **Pitman, W. C., 3d.** Sea-floor spreading and plate tectonics, *in* Tectonophysics, U.S. National Report, 1967-1971, Fifteenth General Assembly, IUGG: EOS, v. 52, no. 5, p. IUGG 130-135, 1971.

This is a summary and bibliography of recent works by U.S. authors on magnetic anomaly lineations from Late Cretaceous to present, regional correlations of magnetic anomaly lineations with Late Cretaceous-Cenozoic time scales; the Pacific Ocean; the Indian Ocean; other magnetic lineations; and plate tectonics. — DBV

Pitman, Walter C., 3d. *See* Hayes, Dennis E. 08451

08621 **Pittman, Edward D.; Duschatko, Robert W.** Use of pore casts and scanning electron microscope to study pore geometry: Jour. Sed. Petrology, v. 40, no. 4, p. 1153-1157, illus., 1970.

Various types of pore casts, replicas of void space, useful for the study of pore geometry can be prepared from rocks impregnated with plastic. Conventional light microscopes are suitable for examination of most pore casts; however, the scanning electron microscope is definitely superior and is essential for good photographic illustrations. Study of pore casts provides information on the distribution and shape of pores and interconnecting passageways that influence permeability and control the flow of fluids. — Authors' abstract

Plafker, George. *See* Miller, Don J. 01009

01147 **Plummer, L. N.** Barite deposition in central Kentucky: Econ. Geology, v. 66, no. 2, p. 252-258, illus., 1971.

Equilibrium calculations depicting the geochemical consequences of mixing a theoretical Mississippi Valley type ore fluid with meteoric water support a hypothesis of barite deposition at an ore fluid-ground water interface. At barite saturation, the ore fluid, a heated connate brine, could transport a barium molality of 5.58. If the activity of barium ion in the ore fluid exceeded $10^{-7.9}$, barite would precipitate as the ore fluid mixed with meteoric ground waters, leaving an oxygen fugacity of 10^{-2}. Areas essentially devoid of barite coincide approximately with the position of an impermeable limestone facies. Proximity of deposits to present ground water table suggests an early to middle Tertiary age for the district. — WSW

01149 **Podwysocki, Melvin H.; Dutcher, Russell R.** Coal dikes that intrude lamprophyre sills, Purgatoire River valley, Colorado: Econ. Geology, v. 66, no. 2, p. 267-280, illus., tables, 1971.

Samples studied come from two intrusions of coal material into and completely through lamprophyric sills. For both intrusions, sulfur decreases with distance for sill, but volatile matter increases for one and decreases for the other. Reflectance, an index of metamorphism, decreases with distance from lamprophyre. Ultimate analyses suggest emplacement at temperatures in the range 375° to 550°C. — WSW

01140 **Pomeroy, Paul W.** Instrumentation and data processing, *in* Seismology, U.S. National Report, 1967-1971, Fifteenth General Assembly, IUGG: EOS, v. 52, no. 5, p. IUGG 190-194, 1971.

Two recent developments in seismometry — a quartz accelerometer stable and sensitive enough to record seismic waves as well as earth tides, and a symmetrical triaxial seismometer which minimizes some problems of natural period vibrations and allows matched response characteristics — allow the study of seismic phenomena over a broad period range. Significant progress has been made in improving existing techniques or introducing new ones for processing seismological data to throw light on tectonic processes in the Earth and earth structure, explain features of the seismograms, and determine earthquake focal data more precisely. Numerous studies were based on data obtained by the LASA array in eastern Montana. Strain investigations included the possibility that large explosions can affect tectonic strain and trigger earthquakes up to a few hundred kilometers away. — DBV

01057 **Poort, Jon M.** Occurrence of *Ophiomorpha* in the basal Upper Cretaceous Providence Formation in Stewart County, Georgia [abs.]: Georgia Acad. Sci. Bull., v. 29, no. 2, p. 124-125, 1971.

01185 **Porath, H.; Dziewonski, A.** Crustal electrical conductivity anomalies in the Great Plains province of the United States: Geophysics, v. 36, no. 2, p. 382-395, illus., 1971.

Magnetic disturbance fields were recorded in 1969 with two magnetometer arrays in the Great Plains, in order to map anomalies due to electrical conductivity inhomogeneities in the crust and to find regions where plane layered models yield resistivity curves that adequately approximate magnetotelluric curves. Variation anomalies were related to lateral changes associated with sedimentary features. Induced currents are concentrated in the conductive sediments of the Anadarko basin of Oklahoma, and give rise to attenuated vertical variation fields west and south of the basin and enhanced fields to the north and northeast. Reversed vertical fields close to the Ouachita tectonic belt in Texas, indicate concentration of induced currents in highly conductive coastal plains sediments. A small variation anomaly is associated with the midcontinent gravity high in the northern Great Plains, probably caused by currents in sedimentary troughs on steep flanks of Precambrian basalts which give rise to the gravity anomaly. — DBV

08562 **Pourret, G.; Bergeron, R.** Les schistes cristallins Grenvilliens de la région du Lac McGillivray [The Grenville crystalline schists of the Lac McGillivray region (with English abs.)]: Canadian Jour. Earth Sci., v. 7, no. 4, p. 1109-1116, illus., tables, 1970.

The principal formations are biotite and amphibolite gneiss which contain levels of leptynites, amphibolites, meta-gabbro, and pyroxene gneiss; the rocks are originally sedimentary and in agreement with the diagrams ACF and A'KF. Some pyroxene amphibolites and the metagabbros show evidence of weak magnetic activity during sedimentation. The paragenesis is described. Three principal phases of flexible deformation are: an axial folding N90° of which the traces are strongly obliterated; an axial folding N40-N60°, and N130-N150° which is very evident. The intersection of the last two fold-sets brought about the formation of the domes or of structures of short elongation. Two kinds of fractures N-S and E-W were the last tectonic events of the region. — *from* Authors' abstract

Powers, Howard A. *See* Gates, Olcott. 01236

01287 **Pratt, Richard M.** Lithology of rocks dredged from the Blake Plateau: Southeastern Geology, v. 13, no. 1, p. 19-38, illus., 1971.

Bottom materials from Blake Plateau off southeastern United States consist of well-sorted foraminiferal sand and, near the Bahama Banks, of carbonate lutite and a rock fraction of limestone, coral, and phosphate and manganese concretions. Limestone is reef rocks from the edge of the continental shelf and indurated foraminiferal cal-

carenite from the Plateau; fossils range from Upper Cretaceous to Recent, but much of the dredged rock is multicyclic. Ahermatypic coral grows in topographic mounds or coral banks up to 20 m high; coral is abundant beneath the axis of the Gulf Stream under long-term equilibrium condition between sedimentation and erosion. Conglomeratic phosphate nodules accumulated as lag gravel after erosion of parent formations by the Gulf Stream. Manganese concretions grow by replacement of phosphate nodules and by simple accretion. The Gulf Stream is the controlling environmental factor. — VSN

Prewitt, C. T. *See* Papike, J. J. 01041

01245 **Priest, Amel.** The physical characteristics of crinoids: Earth Sci., v. 24, no. 2, p. 92-95, illus., 1971.

Parts of the head or body parts of crinoids are described. Adunate crinoids incorporate some brachial plates within the cup, while inadunate crinoids do not. — ESL

01062 **Prowell, David C.; Grant, Willard H.** Ultramafic body near Stone Mountain, Dekalb County, Georgia [abs.]: Georgia Acad. Sci. Bull., v. 29, no. 2, p. 127, 1971.

Pyle, T. E. *See* Antoine, J. W. 08599

R. Ganapathy, R. *See* Keays, Reid R. 01069

08641 **Rahm, D. A.** Post-Miocene erosion of basalt in southeastern Washington [abs.], *in* Columbia River Basalt Symposium, 2nd, Cheney, Wash., 1969, Proc.: Cheney, Eastern Washington State College Press, p. 328, 1970.

01314 **Rampton, Vern.** Late Quaternary vegetational and climatic history of the Snag-Klutlan area, southwestern Yukon Territory, Canada: Geol. Soc. America Bull., v. 82, no. 4, p. 959-978, illus., tables, 1971.

A pollen diagram from pond sediments suggests the following vegetational sequence: 31,000 through 27,000 B.P., fell-field or sedge-moss tundra followed by shrub tundra; 27,000 through 10,000 B.P., sedge-moss tundra; 10,000 through 8700 B.P., shrub tundra; 8700 through 5700 B.P., spruce woodland; 5700 through present, spruce forest. The diagram suggests the following negative departures of July temperatures: 31,000 through 27,000 B.P., at least 8° F., possibly 16° F.; 27,000 through 13,500 B.P., 13° F.; 13,500 through 10,000 B.P., 12° F.; 10,000 through 8700 B.P., 8° F. Logs [C-14 dated] above tree line imply summer temperatures above present values between 6000 and 1220 B.P. Tree-ring studies indicate temperatures during 200 years preceding 1940 as much as 2° F. cooler than present. — *from* Author's abstract

00995 **Rao, S. V. L. N.** Correlation between regression surfaces based on direct comparison of matrices: Modern Geology, v. 2, no. 3, p. 173-177, illus., 1971.

The present paper discusses the various methods by which a set of surfaces can be compared. It is suggested that the least squares summation equations can be rearranged for direct comparison. Treating the matrix in terms of a 'space domain' one can directly compare them by comparing the sloping characteristics of each of these matrices. Various other methods (such as usage of eigenvalues) are also available for comparing the matrices. Study in this direction is currently in progress. — Author's abstract

01290 **Rapp, George R., Jr.; Matsch, Charles L.** University of Minnesota closed-circuit TV course in physical geology, *in* Teaching introductory college geology by television — Council on Education in the Geol. Sci. Pub. 6: Washington, D.C., Amer. Geol. Inst., p. 25-27, 1971.

The use of closed-circuit television in teaching an introduction course in physical geology at the University of Minnesota since 1963 is reviewed. The authors conclude that direct student contact and student response are reduced, whereas the use of a

wide variety of audio-visual materials is increased. The use of VHF bands for transmitting TV courses over educational TV and the use of TV tapes are discussed. — EH

08456 **Rapson-McGugan, J. E.** The diagenesis and depositional environment of the Permian Ranger Canyon and Mowitch Formations, Ishbel Group, from the southern Canadian Rocky Mountains: Sedimentology, v. 15, nos. 3-4, p. 363-417, illus., tables, 1970.

The Ranger Canyon and Mowitch Formations, youngest Permian strata in the Rock Mtn. Front Ranges, form a thin, widespread, clearly defined entity over about 60,000 sq mi; they lie below Triassic beds and above a major regional, intra-Permian unconformity. Rock types are either sandstones or silty and sandy cherts, phosphorites, and some dolomites. Secondary features indicate that diagenesis occurred within a chemically active environment, and mineral contents indicate phosphate and evaporite producing environments derived from sea water by biogeochemical phosphate-fixation and concentration of brines by interstitial refluxion. The coast of Baja California is a modern environmental parallel. The sequence of events in formation of these Permian strata is outlined. — VSN

08504 **Raup, David M.** Modeling and simulation of morphology by computer, *in* Computers in paleontology — North Am. Paleont. Convention, Chicago, Ill., 1969, Proc., Pt. B: Lawrence, Kans., Allen Press, p. 71-83, illus., 1970.

Simulation of morphology has a future in paleontological research only as large as the number of successful models. No amount of computer hardware or programming talent will produce meaningful and useful simulations without appropriate models. At present, effective models are limited to certain aspects of the morphology of a few biologic groups. At the moment the search for models is more important than refinement of computer technology. — DBV

08601 **Rausch, Donald O.; Mariacher, Burt C.** (editors). AIME world symposium on mining and metallurgy of lead and zinc, St. Louis, Missouri, 1970 [Proc.] — V. 1, Mining and concentrating of lead and zinc: New York, Am. Inst. Mining, Metallurgical, and Petroleum Engineers, 1017 p., illus., tables, 1970.

This volume contains the technical papers on the geology and exploration (8); mining operations (9); and concentration of various kinds of lead-zinc ores (22 papers). Appendixes give an abstract of one geophysical paper, and metric-to-English units conversion tables. Also included are four addresses treating the subjects of the general economic setting for the industry, areas of opportunity for further exploration, a survey of operating lead and zinc properties, and promises for the future from process research. Five papers and one abstract are cited separately. — DBV

01179 **Raymond, K. N.; Wenk, H. R.** Luna ilmenite (refinement of the crystal structure): Contr. Mineralogy and Petrology, v. 30, no. 2, p. 135-140, illus., tables, 1971.

The crystal structure of ilmenites from Mare Tranquillitatis and terrestrial basaltic rocks have been refined from X-ray data using least squares methods. The two structures are virtually identical both in structural parameters and relative degree of order. Occupation of Fe and Ti sites is highly ordered. The metal ions have low apparent charges (near 0.3) and formal oxidation state of Fe (II) and Ti (IV). — Authors' abstract

01050 **Rea, David K.; Naugler, Frederic P.** Musicians seamount province and related crustal structures north of the Hawaiian ridge: Marine Geology, v. 10, no. 2, p. 89-111, illus., discussion, 1971.

Musicians seamounts comprise a major volcanic province extending northwest from the Hawaiian Ridge, across Murray Fracture Zone to Pioneer zone at 35° N. Most volcanism is along linear trends or associated with a large uplifted block, appearing to reflect zones of crustal weakness produced during a major change in direction of sea-floor spreading. Seventeen prominent seamounts lie along the 1,200-km line

marking the western limit of the province and along which large east-west fracture zones undergo a change in trend. South of Murray Fracture Zone, five linear structures of coalescing seamounts extend about 300 km eastward from the main line, reflecting en echelon fractures generated following change in spreading direction, and also related to a large uplifted block halfway between Murray and Pioneer zones, which offsets a linear magnetic anomaly that may reflect Early Cretaceous reversal of the magnetic field. — *from* Authors' abstract

Reed, Walter E. *See* Henderson, William. 01358

08589 **Reich, A. R.** Automation of liquid scintillation data processing: Jour. Radioanal. Chemistry, v. 6, no. 2, p. 437-445, tables, 1970.

A program was written in the Basic language to handle scintillation counting by a time-sharing computer. Explanation is given for the use of the program to facilitate the most common types of calculations, as well as the automatic data handling between the spectrometer and the remote computer. The merits of the system are discussed and a sample of the operation and the output is given. — Author's abstract

Renfro, W. C. *See* Cory, R. L. 08676

Rex, David C. *See* Beckinsale, Robert D. 08690

Rex, Robert W. *See* Margolis, Stanley. 01310

08442 **Reybold, William U., 3d.** Soil survey of Talbot County, Maryland: Washington, D. C., U. S. Government Printing Office, 84 p., illus., tables, 1970.

Soils of Talbot County, a part of the coastal plain of Maryland, can be grouped into six associations (defined as a landscape with distinctive pattern of soils): Sassafras-Woodstown, Mattapex-Matapeake, Keyport-Mattapex, Elkton-Othello-Barclay, Fallsington-Pocomoke, and tidal marsh. These associations are shown on a map; brief descriptions indicate the topographic occurrence, ecology, and possible usage for each group. The 19 soil series described include those on made land, mixed alluvial land, steep land, and tidal marsh. The formation of soils of Talbot County and various climatic and other factors in formation are discussed. The geology, physiography, climate, and geography of the region are described. Soil series are shown on aerial photographs of the county. — VSN

01025 **Reynolds, Mitchell W.** Geologic map of the Lamont quadrangle, Carbon County, Wyoming: U.S. Geol. Survey Geol. Quad. Map GQ-912, scale 1:24,000, sections, 1971.

01148 **Reynolds, P. H., Sinclair, A. J.** Rock and ore-lead isotopes from the Nelson batholith and Kootenay arc, British Columbia, Canada: Econ. Geology, v. 66, no. 2, p. 259-266, illus., tables, 1971.

Two isotope populations are recognized within the Kootenay arc. Deposits at some distance from the Nelson batholith appear to be products of simple mixing of ore solutions derived from 1,530 m.y. old upper crustal rocks with Sullivan-type lead (model age about 1,200 m.y.). A second population includes rock lead from the Nelson batholith and galena lead from deposits within and near the batholith. The populations have parallel but separated anomalous lead lines; they can be explained by addition of similar radiogenic component (1,530 m.y.) to different parent common leads during the same major tectonic events. Lead and Rb-Sr isotope data suggest a lower crustal source for much of the lead of the Nelson batholith. — WSW

Rhodes, Rodney C. *See* Elston, Wolfgang E. 08651

08467 **Rice, Raymond M.** Factor analyses for the interpretation of basin physiography [with French abs.], *in* Symposium on the results of research on representative and experimental basins: Internat. Assoc. Sci. Hydrology-Unesco Pub. 96, p. 253-268, illus., tables, 1970.

Factor analysis was used to screen variables describing the physiography of experimental basins on the San Dimas Experimental Forest, southern California, in order to identify variables which would be useful in flood prediction. The analyses utilized 7-12 variables and rotated from 6-9 principal components. Results tend to support the hypothesis that varimax rotation produces factors which are stable in spite of changes in the set of variables. Factor analysis led to hypotheses concerning the internal structure of the basin's physiography, but it did not lead to selection of a set of variables having any great utility in prediction of flood runoff. Multiple regression equations, based on 262 hydrographs resulting from 35 storms on 14 basins, were developed to predict peak discharges. — *from* Author's abstract

01383 **Richmond, Gerald M.; Pierce, Kenneth L.** Surficial geologic map of the Mount Hancock quadrangle, Yellowstone National Park and adjoining area, Wyoming: U.S. Geol. Survey Misc. Geol. Inv. Map I-636, scale 1:62,500, text, 1971.

01011 **Richter, D. H.** Reconnaissance geologic map and section of the Nabesna A-3 quadrangle, Alaska: U.S. Geol. Survey Misc. Geol. Inv. Map I-655, scale 1:63,360, section, 1971.

01012 **Richter, D. H.** Reconnaissance geologic map and section of the Nabesna B-4 quadrangle, Alaska: U.S. Geol. Survey Misc. Geol. Inv. Map I-656, scale 1:63,360, 1971.

01342 **Richter, D. H.; Matson, N. A., Jr.** Quaternary faulting in the eastern Alaska Range: Geol. Soc. America Bull., v. 82, no. 6, p. 1529-1539, illus., table, 1971.

Quaternary faulting is well displayed along the Denali fault system and the recently recognized and related Totschunda fault system. The principal movement on both is right-lateral strike-slip. Offset glacial features of Wisconsin age indicate minimum Holocene slip rates of 1.1 to 3.5 cm per year along parts of the Denali fault system, and 0.9 to 3.3 cm per year along the Totschunda fault system. The Totschunda fault system is aligned with the Fairweather fault in the Gulf of Alaska. The Denali fault system and the Queen Charlotte Islands fault are part of a major transform fault system separating the North American and Pacific plates. Continental southern Alaska between the Aleutian arc and the Denali fault system is now largely coupled to the Pacific plate. The Totschunda-Fairweather alignment probably represents the beginning of a new transform fault by-passing the southeast part of the Denali fault system. — *from* Authors' abstract

Ridler, R. H. *See* Goodwin, A. M. 08627

Ridlon, J. B. *See* Igarashi, Y. 08623

Rieke, Herman H., 3d. *See* Chilingar, George V. 01101

01200 **Rigby, J. Keith; Stokes, W. Lee.** *Haplistion sphaericum* Finks, a rhizomorine sponge, from the Pennsylvanian of southeastern Utah: Jour. Paleontology, v. 45, no. 3, p. 553-554, illus., 1971.

Six specimens of *Haplistion sphaericum* Finks were collected from the Pennsylvanian Hermosa Formation near Spanish Bottom, along the Colorado River in Canyonlands National Park, in southeastern Utah. This is the first report of the genus and species in Utah. — RCD

Riley, F. S. *See* Castle, R. O. 01113

Robeson, D. W. *See* Ayres, L. D. 01111

08488 **Robinson, Charles S.** Environmental aspects of Colorado streets and highway engineering, *in* Governor's Conf. on Environmental Geology: Colorado Geol. Survey Spec. Pub., no. 1, p. 55-66, illus. [1970?].

The Colorado highway system was not designed but inherited. Colorado can be divided broadly into three environmental areas — the high plains; the eastern foothills,

western slope, and major river drainages; and the mountain chains. Each has environmental characteristics that must be considered in the design, construction, and maintenance of a highway system. The main problems in each area are discussed. It is concluded that for modern-day living and surface transportation, most of the towns and highways are in the wrong places. For efficient construction and maintenance of roads, it is essential to understand the climate, physiography, geology, surface and ground-water hydrology, and plant and animal ecology — including man. — DBV

01367 **Robinson, G. B., Jr.** Ground-water hydrology of the San Pitch River drainage basin, Sanpete County, Utah: U.S. Geol. Survey Water-Supply Paper 1896, 80 p., illus., tables, 1971.

This investigation was concerned primarily with the Sanpete and Arapien Valleys of the San Pitch drainage basin, 250 sq mi in central Utah containing the principal ground-water resources, bordered by mountains and plateaus. The average annual precipitation is about 12 in, with about 40 in. in the mountains mostly as snow which is runoff to valley tributaries. Seepage from these tributaries and underflow is the major source of ground water. Unconsolidated fill, mostly alluvial fans and flood deposits ranging from clay to boulders constitute the main water reservoir and yield large quantities to wells. Numerous springs discharge in the mountains and along the margin of Sanpete Valley marked by the Sevier fault. Most water in the bedrock is under artesian pressure and discharges into the fill. The fill pinches out in the south and the ground water discharges into the river or is consumed by evapotranspiration. The ground water in most parts is fresh and suitable for public supply and irrigation. — EHS

Robinson, G. D. *See* Klepper, M. R. 01344

01073 **Rodolfo, Kelvin S.** Contrasting geometric adjustment styles of drifting continents and spreading sea floors: Jour. Geophys. Research, v. 76, no. 14, p. 3272-3281, illus., table, 1971.

The geometry of moving oceanic lithospheric plates is modeled by combining plate subduction and destruction with application of Euler's theorem to the Euclidean sphere of the Earth's surface. A theoretical geometric analysis, tested by data from the eastern Pacific margin, illustrates the unique response to drift of large continental masses. If large enough to comprise a significant fraction of the Earth's circumference, an alignment of continental masses should undergo extension until the frontier between them and the ocean over which they encroach approximates a global great circle; this entails secondary sea-floor spreading transverse to primary spreading, and ductile stretching and fracturing of narrow continental spans. With continued spreading and drift beyond approximation to a great circle, adjacent continents must approach each other along the frontier direction, and stretched and disrupted spans must be 'bent' to account for excess frontier length. American and Antarctic continents and intervening Caribbean and Scotia seas and arcs may have had such a history. — *from* Author's abstract

01166 **Rogers, Thomas H.; Nason, Robert D.** Active displacement on the Calaveras fault zone at Hollister, California: Seismol. Soc. America Bull., v. 61, no. 2, p. 399-416, illus., table, 1971.

Active fault creep has occurred in and near Hollister along a fault trace within the Calaveras fault zone, gradually offsetting various man-made structures in a right-lateral sense. Maximum offset is 33 cm in a sidewalk built between 1909 and 1914. Offsets on dated structures indicate displacement rates of about 2 mm per yr from 1909 to 1925 and 6 mm per yr from 1925 to 1967. Special measurements indicate a rate of 9 mm per yr since May 1967, not associated with local earthquake events. Rates of active fault displacement vary with time and position along the Calaveras and San Andreas fault zones in the Hollister area. The pattern of this variation suggests that active displacement on the San Andreas fault zone may be transferring northeastward to the Calaveras fault zone. — DBV

08483 **Rold, John W.** The Colorado Geological Survey's role in environmental geology, *in* Governor's Conf. on Environmental Geology: Colorado Geol. Survey Spec. Pub., no. 1, p. 20-23, illus. [1970?].

The Colorado Geological Survey's jurisdiction in environmental geologic problems is clearly stated. Three of its eight specific charges or duties deal specifically with environmental geology: to assist, consult, and advise state and local government agencies on geologic problems; to evaluate the physical features of the state with reference to present and potential human and animal use; and to determine areas of natural hazards that could affect the safety of or cause economic loss to citizens of Colorado. The Survey should educate the public to the value of and need for geology, accumulate basic geologic data immediately applicable to environmental problems, point out specific geologic problems before they become crises, and bring the people or agencies experiencing geologic problems together with parties capable of deriving the solutions. — DBV

01096 **Romer, Alfred Sherwood.** Unorthodoxies in reptilian phylogeny: Evolution, v. 25, no. 1, p. 103-112, illus., 1971.

Romer here disagrees with two proposals for modifying the conservative classification of reptiles. Reig (1967, 1970) suggests that the subclass Archosauria arose from primitive Synapsida through the varanopsid sphenacodonts, on evidence of an antorbital fenestra in Permian *Varanodon*, and resemblance of varanopsids to proterosuchians in other features, which Romer thinks are simply primitive reptilian features retained by both groups. Kuhn-Schnyder's (1961-67) suggestion that reptiles arose in some seven separate lines from amphibians is based partly on a supposed amphibian type of otic notch retained in the Triassic nothosaur *Simosaurus*, and the arching of the cheek region in sauropterygians which supposedly denotes diapsid, not euryapsid, ancestry. Romer accounts for these features on other grounds, and points out that the complex amniote pattern of embryonic development in all living reptiles is unlikely to have evolved more than once. — VMJ

08565 **Romer, Alfred Sherwood.** Teaching vertebrate paleontology, *in* Teaching paleontology — North Am. Paleont. Convention, Chicago, Ill., 1969, Proc., Pt. A: Lawrence, Kans., Allen Press, p. 39-46, 1970.

Vertebrate paleontology is mainly based on a background of biology, and an entrant into the field trained solely in geology is under a major handicap. Training should be mainly biological; formal courses in historical geology and stratigraphy from the Paleozoic on are not necessary. Some invertebrate paleontology and a knowledge of sediments are useful. Many of these areas could be covered in undergraduate years. Enrollment in biology for graduate work might seem the proper choice, but as things stand today, it might be equally possible to gain a proper background under either a geologic or a biologic departmental regime at most universities. — DBV

01357 **Rona, Peter A.** Depth distribution in ocean basins and plate tectonics: Nature, v. 231, no. 5299, p. 179-180, illus., 1971.

It is shown that relationships between the movement of lithospheric plates and seafloor depths are leading towards a quantitative theory of oceanic depths. An examination of topographic profiles perpendicular to various sections of the world midocean ridge system supports the inference that topography is a function of spreading rate; the faster the spreading rate within an episode of spreading, the lower the topographic slope and roughness, measured over a distance corresponding to the crust generated during that episode. The depth of a ridge crest increases (from a maximum elevation near the pole of rotation) with the sine of distance from the pole, and the slope of its adjacent flanks decreases with the reciprocal of the sine of distance from the pole of rotation of two lithospheric plates whose boundaries form the ridge. This hypothesis is tested on data from the North Atlantic. — DBV

Rona, Peter A. *See* Brier, Chester. 08559

Roney, James R. *See* Rose, Vincent C. 08558

Roscoe, S. M. *See* Frarey, M. J. 08630

08633 **Roscoe, S. M.; Frarey, M. J.** Comments [on "The Canadian Shield — A status report, 1970" by F. J. Pettijohn, 1970], *in* Basins and geosynclines of the Canadian Shield (A. J. Baer, editor) — Symposium, Ottawa, 1970, Papers: Canada Geol. Survey Paper 70-40, p. 255-262, 1970.

Pettijohn's summation of the symposium (ibid., p. 239-255) includes a number of criticisms of the paper by Frarey and Roscoe on the Huronian Supergroup (ibid., p. 143-158). He has reservations about some of their correlations, doubts that nonmarine sediments are important if present at all, and questions the validity of evidence that a nonoxidizing atmosphere prevailed during deposition of the Lower Huronian. These points were carefully considered before the proposed conceptual model was developed, but could not be treated in a summary paper. These and other criticisms are answered here. — DBV

08558 **Rose, Vincent C.; Roney, James R.** Discussion of "Preliminary evaluation of a core scintillation counter for bulk density measurement in marine sediment cores" [by C. Brier, R. Bennin, and P. A. Rona, 1969]: Jour. Sed. Petrology, v. 40, no. 4, p. 1369, 1970.

For the original paper, *see* ibid., v. 39, no. 4, p. 1509-1519, 1969; Abs. North American Geology, June 1970.

01108 **Rosenau, J. C.; Lubke, E. R.; Nakahara, R. H.** Water resources of north-central Oahu, Hawaii: U.S. Geol. Survey Water-Supply Paper 1899-D, 40 p., illus., tables, 1971.

Half of north-central Oahu is above an altitude of 1,000 feet and receives 71 percent of the 580 million gallons per day average annual precipitation. Recharge to groundwater reservoirs is about 225 mgd. Streamflow to the ocean occurs chiefly during floods. Much of the water diverted for irrigation percolates into ground-water reservoirs. Ground water is available from wells drilled into lava flows and from shallow sedimentary material in the coastal plain. Water used in a dry year averages 93 mgd, 75 mgd for irrigation, and 18 mgd for other uses. Two-thirds comes from groundwater sources and one-third from streams and reservoirs. Ground-water pumpage averages 48 mgd, of which 42 mgd is for irrigation. Salt-water intrusion is not yet a problem but water from a few heavily pumped coastal wells has become moderately saline. — *from* Authors' abstract

Rosenzweig, Abraham. *See* Homme, Frank C. 08656

Ross, David. *See* Habib, Daniel. 08521

Ross, Sylvia H. *See* Summers, W. K. 00992

08654 **Rothrock, Howard E.** Fluorspar, *in* Guidebook of the Tyrone-Big Hatchet Mountains-Florida Mountains region — New Mexico Geol. Soc. Field Conf., 21st, 1970: Socorro, N. Mex., New Mexico Bur. Mines and Mineral Resources, p. 123-125, illus., 1970.

Uses of fluorspar in our economy, southwestern New Mexico's contribution, and possibility of further development are discussed; known occurrences are located on an accompanying map and references given for detailed descriptions. The occurrence of fluorspar and a few characteristics for field identification are summarized. Most of the known deposits in southwestern New Mexico are fissure type, ranging from low-temperature deposits in simple fractures and voids to those deposited by more active fluids in wide brecciated zones; a few veins were favored by anticlinal structure. High-grade, readily accessible ore above mine water level has been extensively mined, but fluorspar resources are not exhausted They must be deeper, because fluorspar is not as definitely zoned as the metals, and has been deposited over a wide range of geologic time, type of host rock, ground preparation, and depth. — GDC

08569 **Rowell, A. J.** The contribution of numerical taxonomy to the genus concept, *in* The genus, a basic concept in paleontology — North Am. Paleont. Convention, Chicago, Ill., 1969, Proc., Pt. C: Lawrence, Kans., Allen Press, p. 264-293, illus., 1970.

The principal contribution of numerical taxonomic studies to the phylogenetic concept of a generic taxon is twofold: (1) They provide the best explicit summary of overall resemblances between the operational taxonomic units studied, and at the same time indicate the amount of distortion in the phenetic model; and (2) when the phenetic model is tested and if necessary adjusted to be consistent with outside data bearing on phylogeny, the resulting adjusted model has high heuristic value, providing a good summary of the inferred phylogeny of the group and forming the basis for subsequent recognition of taxa of generic and higher rank. — DBV

08524 **Roy, Kenneth J.** Change in bathymetric configuration, Kaneohe Bay, Oahu, 1882-1969: Hawaii Inst. Geophysics [Rept.] HIG-70-15 (SEAGRANT 70-6), 26 p., illus., tables, 1970.

The detailed bathymetry of Kaneohe Bay, Oahu, Hawaii, was determined in 1969 from 175 miles of continuous fathometer tracks. Previous detailed surveys had been made in 1927 and 1933. Four physiographic provinces are present in the Bay: fringing reef, lagoon, barrier reef, and passes. It can be divided further into lagoon floor and patch reefs. The configuration of the barrier reef shows relict stream-drainage topography dating from a lower stand of sea level. Changes in bathymetry varied only slightly between 1882 and 1927, but since 1927 the lagoon, between barrier reef and shore, has become shallower by an average of 5.4 feet as a result of increased reef erosion and runoff from the land, all induced by man's activities. The rate of infilling is not known. If it started in 1927, the Bay may last several hundred years; if it started recently, the Bay may be filled in less than 100 years. — VSN

Ruddiman, William F. *See* Fox, Paul J. 08600

Rudrum, M. *See* Blumer, M. 08564

08620 **Runnells, Donald D.** Errors in X-ray analysis of carbonates due to solid-solution variation in composition of component minerals: Jour. Sed. Petrology, v. 40, no. 4, p. 1158-1166, illus., table, 1970.

Calculations of the relative integrated intensities of the two principal reflections from calcite, magnesite, siderite, rhodochrosite, dolomite, ankerite, and kutnahorite show the strongest reflection, [211] ([1014] referred to hexagonal axes) highly sensitive to isomorphous substitution of cations. The [210] ([1123] referred to hexagonal axes) reflection is the second strongest for most compositions of the rhombohedral carbonates. It is practically independent of solid-solution variation and makes an ideal choice for the analysis of mixtures. Calibration curves involving and internal standard show that if a component mineral comprises more than 8 percent weight of a sample, the [210] reflection will be strong enough to utilize. Cerric oxide is recommended as an internal standard. — *from* Author's abstract

01362 **Rutherford, G. K.** The properties, genesis and geomorphological relationships of a sequence of soils on a limestone plain in southeast Ontario, Canada: Geoderma, v. 5, no. 3, p. 179-196, illus., tables, 1971.

A sequence of soils was studied on a cross-section transverse to a drumlin, continuing across lacustrine and alluvial deposits and terminating on a ridge. Calcareous till was deposited on a scoured, flat limestone plain during the last advance of the Wisconsin ice sheet and locally formed drumlins. Lacustrine sediments were then deposited in water ponded between the drumlin and dead ice on the valley floor. After the ice melted, alluvium was deposited in the valley. Gray-brown luvisolic soils developed on the drumlin, gray wooded soils on the lacustrine deposits, gleysol on the alluvium and brunisolic soils on the calcareous till. Absence of buried soils indicates that the present ground surface and soils formed since shortly after the retreat of the ice. The big differences in properties of the soils in this sequence are due to the nature of the parent material and to the geomorphic situation. — *from* Author's abstract

Ryan, William B. F. *See* Fox, Paul J. 08600

Salisbury, John W. *See* Hunt, Graham R. 00996

01127 **Sammis, Charles G.** Theoretical equations of state, *in* Tectonophysics, U.S. National Report, 1967-1971, Fifteenth General Assembly, IUGG: EOS, v. 52, no. 5, p. IUGG 122-126, 1971.

Both the refinement of seismic velocity profiles of the Earth and the accumulation of laboratory data for oxides and silicates during the past four years have led to an increased amount of work on theoretical equations of state. This is a summary and bibliography of works by U.S. investigators on systematics, finite strain, atomistic theories Grüneissen's constant, and aggregate profiles. – DBV

Sanford, Allan R. *See* Hanson, Merle E. 01083

01216 **Sangrey, D. A.; Paul, M. J.** A regional study of landsliding near Ottawa [with French abs.]: Canadian Geotech. Jour., v. 8, no. 2, p. 315-335, illus., table, 1971.

In an examination of stability of natural slopes near Ottawa, the density and distribution of past landslides have been ascertained, and the development of more recent slides has been traced. This data, combined with details of present day topography, groundwater conditions, and soil characteristics, indicates that factors influencing slope stability vary markedly throughout the region, and certain areas are much more prone to sliding than others. Strength of soils in the region is discussed, including development of a logical shear strength relation which incorporates effects of cementation strength and fissuring. The influence of sample size on extrapolation of laboratory triaxial test results to field situation is introduced. Details of the method of landslide analysis used are given. Evidence is presented to support separate marine and freshwater clay layers in the Ottawa area, and to suggest that flow slides are confined to the upper freshwater deposit. — *from* Authors' abstract

01084 **Sass, J. H.; Lachenbruch, Arthur H.; Munroe, Robert J.** Thermal conductivity of rocks from measurements on fragments and its application to heat-flow determinations: Jour. Geophys. Research, v. 76, no. 14, p. 3391-3401, illus., tables, 1971.

A series of measurements indicates that the thermal conductivity of a rock generally can be estimated adequately for geophysical purposes from simple laboratory measurements on fragments of the rock. The solid-rock conductivity is deduced from a divided-bar measurement of the conductivity of a cylindrical cell containing water-saturated rock fragments. All determinations fall within about ten percent of conventionally measured solid-rock values for a variety of crystalline and sedimentary rocks with conductivities ranging from about 3 to 14 mcal/cm sec °C. Good agreement is found between values determined from drill cuttings and solid core from the same depth in deep boreholes. The method is illustrated by the determination of heat flow in a 3-km-deep borehole near Tehran, Iran (35°50′ N. latitude, 51°37′ E. longitude; elevation, 1710 meters). Contrasting gradients are compensated by conductivity variations determined from drill cuttings. Component heat flows show good agreement with a mean of 2.1 ±0.1 μcal/cm^3 sec. — Authors' abstract

Sawabini, Costandi T. *See* Chilingar, George V. 01101

08568 **Schaeffer, Bobb.** Mesozoic fishes and climate, *in* Paleoclimatology — North Am. Paleont. Convention, Chicago, Ill., 1969, Proc., Pt. D: Lawrence, Kans., Allen Press, p. 376-388, illus., 1970.

The extensive north-south distribution of Mesozoic ceratodontids and certain actinopterygian groups is best explained by a zone of essentially uniform climate embracing all the continents including Antarctica, regardless of their relative positions. Although this zone may have narrowed at intervals during the Mesozoic and presumably was more or less permanently contracted in the Late Cretaceous, the evidence from the fishes supports the deduction based on plants, invertebrates, other vertebrates, and oxygen isotopic determinations in favor of a tropical to subtropical climate. — DBV

Schaeffer, Frederick E. *See* Crittenden, Max D., Jr. 01161

01017 **Schlanger, Seymour O.; Weir, Gordon W.** Geologic map of the Mount Vernon quadrangle, Rockcastle County, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-902, scale 1:24,000, sections, text, 1971.

01306 **Schnitker, Detmar.** Distribution of foraminifera on the North Carolina continental shelf: Tulane Studies Geology and Paleontology, v. 8, no. 4, p. 169-215, illus., tables, 1971.

The quantitative distribution of 164 species of foraminifera has been studied from 86 samples from the continental shelf of North Carolina. A major faunal boundary exists at the latitude of Cape Hatteras. It is possible to distinguish a syn-thanatotope of the central shelf with a lower boundary of about 60 m and a syn-thanatotope of the shelf edge. The total number of both benthonic and planktonic specimens increases with increasing depth. A relict fauna on the outer portions of the central shelf and shelf edge indicates a sea-level rise of about 60 m since the last glaciation. Faunal diversity is higher south of Cape Hatteras because of the stabilizing influence of the Gulf Stream. — *from* Author's abstract

01128 **Scholz, Christopher H.** Rock mechanics and dynamic processes in the crust, *in* Tectonophysics, U.S. National Report, 1967-1971, Fifteenth General Assembly, IUGG: EOS, v. 52, no. 5, p. IUGG 126-130, 1971.

Experimental and theoretical studies in the past four years of the fracture and flow of rock have provided new insights into dynamics of geologic processes in crust and upper mantle. Intensive observations, particularly along the San Andreas fault, have yielded new information on the mechanism of earthquakes and faulting. This is a summary and bibliography of publications on the frictional characteristics of rock under crustal temperature and pressure conditions, with application to faulting mechanism; laboratory experiments as scale models of seismicity, with applications to earthquake statistics; fault creep over extensive portions of the San Andreas fault system; geologic, geodetic, and seismic data on rates of movement and strain accumulation on the San Andreas fault; observations and experiments on earthquake triggering; and rock creep at high temperatures and pressures. — DBV

01160 **Schouten, J. A.** A fundamental analysis of magnetic anomalies over oceanic ridges: Marine Geophys. Researches, v. 1, no. 2, p. 111-144, illus., 1971.

A spectral description allows the anomaly caused by a specific magnetic model to be described in terms of wavelength, amplitude, and phase. For a two-dimensional symmetrical magnetization distribution related to ocean floor spreading, phase is defined by the degree of asymmetry of the anomaly which depends on the inclination of the magnetization and on the strike of the symmetry axis. The degree of asymmetry as function of strike varies with magnetic latitude. A convolution method is derived which eliminates the phase (asymmetry) and permits comparison of magnetic patterns. This method is applied to magnetic anomalies over the Mid-Atlantic Ridge on line Golf (28° N.). Results show asymmetry of anomalies to be consistent with the postulated model using vertical magnetization discontinuities. A cross-correlation procedure applied to convolved magnetic anomalies on line Golf and line Hotel (31° N.) shows a WNW-ESE striking fracture zone offsetting the crustal pattern in a clockwise manner. — *from* Author's abstract

01197 **Schram, Frederick R.** *Litogaster turnbullensis* (sp. nov.) — A Lower Triassic glypheid decapod crustacean from Idaho: Jour. Paleontology, v. 45, no. 3, p. 534-537, illus., table, 1971.

A specimen of a new species of decapod crustacean assigned to the genus *Litogaster* von Meyer 1847 is described from the Lower Triassic Thaynes Formation near Hot Springs, Bear Lake, Idaho. The occurrence of this specimen effectively extends the geographic range of the genus *Litogaster*, hitherto exclusively in the German Triassic, to North America. — Author's abstract

Schreiber, Edward. *See* Liebermann, Robert C. 01131

Schrijver, K. *See* Martignole, J. 01250

01032 **Schwarz, Harry E.** Water resources systems, *in* U.S. National Report, 1967-1971, Fifteenth General Assembly, IUGG, — Oceanography: EOS, v. 52, no. 6, p. IUGG 305-311, 1971.

The period 1966-70 has been one of extensive development of practical methods for taking into account hydrologic uncertainty in water resources studies. The new techniques are based on an assumption that historic hydrologic events are sample functions from a complex stochastic hydrologic process, from which it follows that future events will also be sample functions of the same process. Work on stochastic stream flow and rainfall models; data networks; and surface water, ground water, and water quality systems is summarized. — DBV

08490 **Scott, A. J.; Fisher, W. L.** Delta systems and deltaic deposition, *in* Delta systems in the exploration for oil and gas — A research colloquium, Austin, Texas, 1969, Syllabus [No. 1] (W. L. Fisher; L. F. Brown, Jr.; A. J. Scott; J. H. McGowen, leaders): Austin, Texas, Univ. Texas at Austin Bur. Econ. Geology, p. 10-29, illus. [1970?].

These discussion notes include delta formation, the characteristics of principal delta facies, basic delta types and Holocene models, and stratigraphic classification of delta systems. — DBV

Scott, Alan J. *See* Fisher, W. L. 08570

Scott, B. P. *See* Money, P. L. 08631

08702 **Scott, Walter H.** Oceanography and the continental shelf resources of Alaska, *in* The use of remote sensing . . . of natural resources of Alaska: Juneau, Alaska, Dept. of Econ. Devel., p. 55-57, illus. [1970].

The continental shelves, as extensions of the land, are sources of petroleum and other minerals. Knowledge of the oceans and their floors and shelves has been obtained by various types of submarine and airborne research. Aircraft are used for coastal, ice field and iceberg, magnetometer and temperature surveys as well as for monitoring pollution. Navigation, communication and weather satellites are important sources of data on ocean temperature variations and current patterns, cloud formations and storms, and offshore mineral resources. — EH

Scrutton, R. A. *See* Stacey, A. P. 01187

01211 **Seiglie, George A.; Bermúdez, Pedro J.** An additional note on the foraminiferal genus *Glaucoammina* and *Reophax caribensis*: Tulane Studies Geology and Paleontology, v. 8, no. 4, p. 221-222, 1971.

Three different forms of the variable foraminifer *Reophax trilateralis* type specimen of the genus *Glaucoammina*, were included in its original description. The third form, which is the object of this note, consists of an initial enlarged portion followed by two or three uniserial chambers. The initial portion was originally interpreted as probably trochospiral, but reexamination of the material suggests that the initial portion could be the enlarged first chamber of a megalosphaeric form. A second objective of this note is to emphasize the differences between *R. caribensis* Seiglie and Bermudez and "*R. scorpiurus* Montfort." It is shown that "*R. scorpiurus* Montfort" must be considered a *nomen dubium*. — DBV

08443 **Selley, Richard C.** Ancient sedimentary environments — A brief survey: Ithaca, New York, Cornell University Press, 237 p., illus., tables, 1970.

This book shows how the depositional environments of sedimentary rocks can be recognized. It is designed as an introductory survey for readers with a basic knowledge of geology but not for the specialist sedimentologist. The text has 12 chapters as follows: introduction; river deposits; wind-blown sediments; lake deposits; deltas; linear clastic shorelines; mixed clastic-carbonate shorelines; carbonate shorelines and shelf deposits; reefs; flysch and turbidites; pelagic deposits; and conclusions. — VSN

Serra, J. *See* Marechal, A. 08615

Shaffer, Ronald J. *See* Hanson, Merle E. 01083

08588 **Shah, K. R.; Filby, R. H.; Haller, W. A.** Determination of trace elements in petroleum by neutron activation analysis — Pt. 2, Determination of Sc, Cr, Fe, Co, Ni, Zn, As, Se, Sb, Eu, Au, Hg, and U: Jour. Radioanal. Chemistry, v. 6, no. 2, p. 413-422, illus., tables, 1970.

Neutron activation analysis (INAA) and Ge(Li) spectrometry have been used to determine Sc, Cr, Fe, Co, Ni, Zn, As, Se, Sb, Eu, Au, Hg, and U in crude petroleum. The technique involves no chemical separations and no preconcentration of the samples by ashing is necessary, thus avoiding contamination or loss of volatile elements. The estimated detection limits in ppb for the elements are Sc(0.1), Cr(0.16), Fe (400.0), Co(0.6), Ni (1.1), Zn (200.0), As (6.0), Se (23.0), Sb (1.0), Eu (0.58), Au (0.11), Hg (4.3), U (1.5). Precision values range from 0.1 percent to 15 percent (relative standard deviation). Interferences in the Co and Fe determinations due to fast neutron reactions and on Ni isotopes are small and easily corrected. Losses of As, Se, and Hg during irradiation are negligible. — *from* Authors' abstract

01221 **Shamir, U.; Dagan, G.** Motion of the seawater interface in coastal aquifers — A numerical solution: Water Resources Research, v. 7, no. 3, p. 644-655, illus., 1971.

Partial differential equations that describe motion of the seawater interface and free surface in a phreatic coastal aquifer (or freshwater head replacing the latter, in the confined case) are presented; they are based on the Dupuit approximation and consider geometry of the vertical section through the aquifer, in whose plane flow takes place, as well as spatial variation of properties of the medium and spatial and temporal distributions of accretion, recharge, and pumping. An implicit numerical scheme, which solves the simultaneous partial differential equations, is based on linearization of equations and employs a grid with one spacing over intrusion length and a different spacing in the remainder of the field. Efficient solution of the resulting set of equations for each time step is achieved by arranging them in a way that results in a 7 diagonal coefficient matrix. Examples are given. — *from* Authors' abstract

Shaw, C. E. *See* Statler, A. T. 01303

01311 **Shaw, H. R.; Kistler, R. W.; Evernden, J. F.** Sierra Nevada plutonic cycle — Pt. 2, Tidal energy and a hypothesis for orogenic-epeirogenic periodicities: Geol. Soc. America Bull., v. 82, no. 4, p. 869-895, illus., table, 1971.

It is proposed that the energy dissipated from solid earth tides is concentrated along oceanic ridge systems and in the aesthenosphere. This energy localizes and sustains sources of sea-floor spreading. Energy components enter the continent as magmatic heat with temporal maxima every 30 m.y. These maxima are explained as the result of periodic thermal instabilities in the mantle. Calculated periodicities are compatible with Sierra Nevada intrusive epochs, Mesozoic eustatic oscillations, and concepts of sea-floor spreading. — AG

Shaw, H. R. *See* Kistler, R. W. 01384

08545 **Shaw, H. R.; Swanson, D. A.** Eruption and flow rates of flood basalts, *in* Columbia River Basalt Symposium, 2nd, Cheney, Wash., 1969, Proc.: Cheney, Eastern Washington State College Press, p. 271-299, illus., 1970.

The two principal objectives of this paper are qualitative identification of characteristic steps in an eruption cycle and derivation of numerical estimates for rates of eruption and lava emplacement. Most of the assumed physical constraints derived from the observable features of flood basalts refer to flows from Yakima Basalts exposed in Washington and Oregon. After a brief description of the Yakima Basalt and its setting, some of the mechanical conditions attending volcanic eruptions from sources in the lower crust or upper mantle are qualitatively identified, and the numerical interpretations are given for those steps amenable to limiting simplifications. — DBV

08643 **Shaw, H. R.; Swanson, D. A.** Speculations on the fluid mechanical history of Yakima Basalt flows [abs.], *in* Columbia River Basalt Symposium, 2nd, Cheney, Wash., 1969, Proc.: Cheney, Eastern Washington State College Press, p. 330, 1970.

01098 **Shaw, Neva L.** Iowa's ancient bison: Gems and Minerals, no. 405, p. 18, 20, illus., 1971.

A recent find of the complete skeleton of a bison on the Arling Hughes' farm, 3 mi southeast of Marion, Iowa, is described. The animal probably lived before the last glacial advance about 25,000 to 50,000 yr ago, and the skeleton is about one-third larger than the modern bison. The skeleton will be reassembled and placed on display in the museum of the Department of Geology, University of Iowa. — VSN

01090 **Sheppard, Richard A.** Clinoptilolite of possible economic value in sedimentary deposits of the conterminous United States: U.S. Geol. Survey Bull. 1332-B, p. B1-B15, illus., table, 1971.

Clinoptilolite is a very common zeolite, and it has formed in sedimentary rocks of diverse lithology, age, and depositional environment. Extensive and nearly monomineralic beds of clinoptilolite are especially common in Cenozoic rocks that originally contained silicic vitric material. Clinoptilolite is potentially valuable for many industrial and agricultural processes, and it may find extensive use in the control of water pollution by the removal of ammonia from wastewater. — Author's abstract

Shields, W. R. *See* Garner, E. L. 01399

01229 **Shipboard Scientific Party.** Leg 4 of the Deep Sea Drilling Project: Science, v. 172, no. 3989, p. 1197-1205, illus., table, 1971.

This article first presents conclusions resulting from knowledge of the geology of the Western Atlantic and Caribbean basins (Brazilian Basin, North Brazilian Ridge, Vema Fracture Zone, North Side of the Demerara Abyssal Plain, Outer Ridge, Venezuelan Basin, Aves Ridge, and Beata Ridge) obtained by Leg 4 of the Deep Sea Drilling Project which began in January 1969. Then follows a general discussion of several topics of interest developed on Leg 4, particularly the problems of sedimentation rates, history of calcium carbonate compensation in the Atlantic, and nature and relations of subbottom reflectors. — DBV

Shorty, J. C. *See* Akers, J. P. 01296

08673 **Shotwell, J. Arnold.** Pliocene mammals of southeast Oregon and adjacent Idaho: Oregon Univ. Mus. Nat. History Bull. 17, 103 p., illus., tables, 1970.

Pliocene mammalian faunas in the northern Great Basin are treated, as a sequel to the late Miocene fauna of southeastern Oregon (Shotwell, 1968). A number of Pliocene faunas have been described previously; the present work covers new samples of the Black Butte fauna (Clarendonian, Juntura Formation), Drewsey Formation fauna (Hemphillian, including Bartlett Mtn. and Otis Basin faunas), Little Valley-Juniper Creek fauna (Hemphillian, Grassy Mtn., and Chalk Butte Formations), all in Oregon, and the Grand View fauna in southwestern Idaho (Blancan, Glenns Ferry Formation). Faunal and stratigraphic correlations are discussed; the Grand View fauna is considered close in age to the Hagerman fauna, 70 mi to the east. Sixty mammalian taxa are described, including three new species, a beaver and a mustelid from Little Valley and a beaver from Grand View. Relation of *Plesippus idahoensis*, abundant in the Grand View, to other equines is discussed at length. — VMJ

Shubinski, Robert P. *See* Orlob, Gerald T. 08471

01276 **Shukla, S. S.; Syers, J. K.; Williams, J. D. H.; Armstrong, D. E.; Harris, R. F.** Sorption of inorganic phosphate by lake sediments: Soil Sci. Soc. America Proc., v. 35, no. 2, p. 244-249, illus., tables, 1971.

Noncalcareous sediments usually sorbed more added inorganic P than calcareous sediments. The proportion of added P sorbed was closely related to the amount of oxalate Fe and to the levels of native total inorganic P in the sediments. A gel complex, dominated by hydrated iron oxide, is postulated as the major contributor to sorption of inorganic P by Wisconsin lake sediments. — Soil brief

Silver, L. T. *See* Anderson, C. A. 01100

08432 **Simpson, E. S.; Thorud, David B.; Friedman, Irving.** Distinguishing winter from summer recharge to groundwater in southern Arizona by deuterium analysis [abs.] [also French, Spanish, and Russian versions, *in* Symposium on World Water Balance, V. 1: Internat. Assoc. Sci. Hydrology-Unesco Pub. 92, p. 100-101 [1970?].

08587 **Sims, P. K.; Morey, G. B.; Ojakangas, R. W.; Viswanathan, S.** Geologic map of Minnesota, Hibbing sheet, bedrock geology: [Minneapolis, Minn.] Minnesota Geol. Survey, scale 1:250,000, 1970.

Sirkin, Leslie A. *See* Connally, G. Gordon. 01316

08517 **Sloan, Robert E.** Cretaceous and Paleocene terrestrial communities of western North America, *in* Evolution of communities — North Am. Paleont. Convention, Chicago, Ill., 1969, Proc., Pt. E: Lawrence, Kans., Allen Press, p. 427-453, illus., 1970.

The variation in late Cretaceous and Paleocene communities in western North America are controlled in part by regional variations in vegetation and climate, which are in part determined by transgression and regression of the Gulf of Mexico and the western interior sea. There are both regional variations in communities and temporal differences in regions. Many regional differences are controlled by latitude; there are some longitudinal differences between contemporary North American and European Paleocene and Eocene faunas. Adaptive radiation of placental mammals can be located in time and space on the basis of present collections. The fossil record in western North America demonstrates many of the transitions between placental orders. — DBV

08481 **Slosson, James E.** The role of engineering geology in urban planning, *in* Governor's Conf. on Environmental Geology: Colorado Geol. Survey Spec. Pub., no. 1, p. 8-15 [1970?].

A complete analytical geologic study prior to the design of a master plan, tract map, dam site, highway, and so forth will not only avoid the possibility of an unsafe and(or) unstable condition, but in almost every situation will aid in the creation of the most economical and efficient construction criteria. Failure of the Saint Francis dam was probably one of the most important individual events to stimulate recognition of the need for engineering geology. A table giving data on failures on construction sites in Los Angeles for three periods clearly demonstrates that adequate in-depth engineering-geology studies teamed with capable soils and design engineering will produce safe, stable, and economically feasible urban developments. Geology should precede all design work. A development in Los Angeles is cited as an example of well coordinated planning. — DBV

Smedes, H. W. *See* Klepper, M. R. 01344

01261 **Smith, J. T.; Nichols, I. K.** Walter Eric Nygren (1907-1971): Houston Geol. Soc. Bull., v. 13, no. 10, p. 22-23, portrait, 1971.

08555 **Smith, M. H.** Identification of organic matter in thin section by staining and a study programme for carbonate rocks: Jour. Sed. Petrology, v. 40, no. 4, p. 1350-1351, 1970.

A method for the identification of organic material in thin section using biological stains is described and placed in context as part of a study programme for carbonate rocks. — Author's abstract

01086 **Smith, Merritt B.; Engler, Vivian L.; Lee, Della I.; Horn, Katherine J.; Wayland, Russell G.** (compilers). Reported occurrences of selected minerals in the central third of California: U.S. Geol. Survey Mineral Inv. Resource Map MR-48, scale 1:500,000, 1971.

Smylie, D. E. *See* Johnson, Ian M. 01264

08642 **Snavely, P. D., Jr.; MacLeod, N. S.** Local centers of Miocene volcanism along coastal Oregon and Washington [abs.], *in* Columbia River Basalt Symposium, 2nd, Cheney, Wash., 1969, Proc.: Cheney, Eastern Washington State College Press, p. 329, 1970.

Snellenburg, Jonathan. *See* Lyons, John B. 01352

08683 **Snyder, Don O.** Fossil evidence of Eocene age of Baca Formation, New Mexico, *in* Guidebook of the Tyrone-Big Hatchet Mountains-Florida Mountains region — New Mexico Geol. Soc. Field Conf., 21st, 1970: Socorro, N. Mex., New Mexico Bur. Mines and Mineral Resources, p. 65-67, illus., 1970.

The Baca Formation crops out discontinuously in central Socorro and Catron Counties along an east-west belt, 120 mi long by 20 mi wide. The formation is a suite of terrestrial sediments averaging 700 feet in thickness, with a maximum of 2500 feet reported in a wildcat oil test drilled south of Pietown. Discovery and identification of mammal teeth, found 123 feet above the base of the formation, about 15 mi north of Datil, confirm that the Baca Formation west of the Rio Grande is the same age (Eocene) as that on the east side in the vicinity of the Carthage coal field. Well-preserved molars were identified as cf. *Protoreodon pumilus* of late Eocene age, an ancestor of modern sheep. Among other fossil fragments are probable sections of rib bones. — GDC

08602 **Snyder, Frank G.** Structural lineaments and mineral deposits, eastern United States, *in* AIME world symposium on mining and metallurgy of lead and zinc, St. Louis, Missouri, 1970 [Proc.] — V. 1, Mining and concentrating of lead and zinc: New York, Am. Inst. Mining, Metallurgical, and Petroleum Engineers, p. 76-94, illus., tables, 1970.

Major east-west lineaments influencing the localization of lead-zinc districts in shallow-water shelf carbonate host rocks are suggested by alinement of occurrences, alkalic intrusions, and cryptoexplosion structures. The best defined lineaments are the 38th Parallel Lineament with 8 mineral districts, 10 igneous events, and 8 explosion structures alined along a 1,200-mi length, and the Tennessee Lineament with an alinement of 10 mineral districts, 3 igneous events, and 5 explosion structures along an 800-mi length. These and other less well defined possible lineaments may be continental effects of major transcurrent faults in the ocean basin or mantle currents beneath the continent. Magma, gas, and heat are released from the upper mantle into segments of the lineaments. — DBV

01099 **Snyder, James E.** Salt mine pseudomorphs: Gems and Minerals, no. 405, p. 24-26, 43-44, illus., 1971.

Characteristics of glauberite and its gypsum, calcite, and aragonite pseudomorphs found at "The Salt Mine" about two mi southwest of Camp Verde, Yavapai County, Arizona, are described to clear up existing confusion on identification. An identification guide includes properties of thenardite which is common in the mine. — VSN

01285 **Spoljaric, N.** Origin of colors and ironstone bands in the Columbia Formation, Middletown-Odessa area, Delaware: Southeastern Geology, v. 12, no. 4, p. 253-266, illus., tables, 1971.

Colors in the Columbia Formation (Pleistocene) in the study area are dependent on the amount of iron present. The source of iron is the underlying greensand of the Rancocas Formation (Paleocene-Eocene). Iron seems to have been transported from its source by ground water and precipitated in the capillary fringe zone and zone of watertable fluctuations. Ironstone bands, however, are thought to have been formed

in the zone of aeration by precipitation of iron from ground water. In general there is no relationship between shape and size of ironstone bands and textures and structures of sediments that contain them. Shapes of bands reflect the type of groundwater flow at the time of formation. — *from* Author's abstract

01320 **Spoljaric, N.** Recognition of some primary sedimentary structures of fluvial sediments in the subsurface: Geol. Soc. America Bull., v. 82, no. 4, p. 1051-1054, illus., 1971.

A method of recognition of some primary sedimentary structures of fluvial sediments in the subsurface, where these structures cannot be seen, has been developed. The method is based upon two independent criteria, and it employs three sedimentary parameters: mean grain size, skewness, and kurtosis. — Author's abstract

Sproll, W. P. *See* Dietz, R. S. 08693

01187 **Stacey, A. P.; Fasham, M. J. R.; Black, D. I.; Scrutton, R. A.** Design and application of digital filters for the Graf-Askania Gss2, No. 11 sea gravity meter: Marine Geophys. Researches, v. 1, no. 2, p. 220-232, illus., 1971.

With knowledge of the response characteristics of the Graf-Askania Gss2, No. 11 gravity meter it has been possible to design a digital filter to correct for the attenuation and time lag caused by the heavy magnetic damping of the beam. Other filters have also been designed to ensure that all parameters related to the measurement of gravity at sea have a similar cut-off frequency. The filters are able to operate in an on-line reduction mode if required. The method has been used on data recorded at sea to illustrate attenuation and time lag corrections and its suitability in rough weather. — Authors' abstract

Stall, John B. *See* Yang, Chih Ted. 01222

01364 **Stallman, Robert W.** Aquifer-test design, observation and data analysis: U.S. Geol. Survey Water-Resources Inv. Techniques, Book 3, Chap. B1, 26 p., illus., table, 1971.

This report describes the common framework on which all aquifer test analysis is based, details procedures for designing a test, emphasizes the importance of criteria to be met in design and field execution of aquifer tests, and calls attention to required data. Testing is based on the working hypothesis that Darcy's law gives a satisfactory approximation of ground-water flow and that for many field situations water storage in an aquifer is proportional only to head; thus, it is feasible to predict head distribution in an aquifer with respect to space and time. — VSN

08498 **Stanley, Steven M.** Relation of shell form to life habits of the Bivalvia (Mollusca): Geol. Soc. America Mem. 125, 296 p., illus., tables, 1970.

Study of 95 common western North Atlantic bivalve (pelecypod) species representing 29 families has demonstrated that morphologic features of the shell other than hinge type and microstructure primarily reflect life habits and habitat preferences. Although dealing almost exclusively with living species, this study has been undertaken chiefly for application to paleontologic studies of extinct taxa. Many morphologic features represent potentially powerful tools for paleoecologic and evolutionary interpretation. Evolutionary divergence, convergence, and homeomorphy support functional interpretations and provide strong arguments for the adaptive nature of shell form in the Bivalvia. — *from* Author's abstract

01049 **Stapor, F. W.** Sediment budgets on a compartmented low-to-moderate energy coast in northwest Florida: Marine Geology, v. 10, no. 2, p. M1-M7, illus., discussion, 1971.

Sediment budgets for portions of the Franklin and Gulf County, Florida, coasts have been determined through comparison of old (1860's-1940's) U.S. Hydrographic Office smooth sheets. Rate of erosion and deposition and, significantly, minimum

distances of transport were computed. This coast is divided into at least six individual compartments (or longshore drift cells) which most probably experience minimal communication; in each instance erosion and deposition are nearly balanced. This compartmentalization is effected by the low-to-moderate wave energy and the offshore bathymetry of the region. — Author's abstract

01269 **Starkey, J.; Palmer, H. C.** The sensitivity of the conglomerate test in palaeomagnetism: Royal Astron. Soc. Geophys. Jour., v. 22, no. 3, p. 235-240, illus., table, 1971.

Samples of 25, 74, 100, and 200 directions have been drawn from a population of uniformly distributed directions. The directions were summed vectorially, and the direction and length, R, of the resultant vector was calculated. Bias was applied to the random samples by adding a common vector to each random direction in varying proportions. This corresponds to the addition of a secondary component of magnetization of varying magnitude to randomly oriented primary magnetic directions, as might be present in the pebbles of a conglomerate. A comparison between the values of R calculated from the biased and unbiased samples permits estimates to be made of the sensitivity of conglomerate tests based on different sized samples in detecting secondary components of magnetization. — Authors' summary

01303 **Statler, A. T.; Shaw, C. E.** Major oil discovery sparks Tennessee wildcat play: World Oil, v. 172, no. 7, p. 93-96, illus., 1971.

A major oil discovery, the Oneida West field in Scott Co., Tennessee, is producing 2500-3000 bpd from the lower Mississippian Fort Payne Formation. The field is on the southeast flank of the Cincinnati Arch, 25 mi east of the Mississippian outcrop belt. Production is from a 0-60 ft lens of vuggy non-certy limestone overlain by tight siltstone and fine-grained sandstone and underlain by very cherty and siliceous limestone or dolomite. The contact between the cherty and non-cherty carbonates is sharp and irregular, perhaps erosional. Comparable Fort Payne reservoirs may be present over a large area in the northern Cumberland Plateau. — CWC

01167 **Stauder, William.** Smaller aftershocks on the BENHAM nuclear explosion: Seismol. Soc. America Bull., v. 61, no. 2, p. 417-428, illus., table, 1971.

The spatial distribution of 162 BENHAM aftershocks about an order of magnitude smaller than those previously studied is similar to that found for larger events. Focal mechanisms are also similar: dip-slip along northeasterly trending zones and generally strike-slip along a north-south trending zone west of the shotpoint. About one third of the solutions are ambiguous, capable of either interpretation; about half of these cases are successfully resolved by using amplitude data. The aftershocks of the explosion follow a recurrence rate normal for regional earthquakes or aftershock sequences. — DBV

08607 **Stearns, Richard G.; Colvin, John M., Jr.; Johnson, Robert W., Jr.** Magnetic, gravity, and structural patterns of a part of north central Tennessee and adjacent Kentucky [Abs.], *in* AIME world symposium on mining and metallurgy of lead and zinc, St. Louis, Missouri, 1970 [Proc.] — V. 1, Mining and concentrating of lead and zinc: New York, Am. Inst. Mining, Metallurgical, and Petroleum Engineers, p. 997-998, 1970.

Steel, Gordon. *See* Henderson, William. 01358

01109 **Steele, Eugene K., Jr.** Use of groundwater for irrigation in Hamilton and York Counties, Nebraska: Nebraska Water Survey Paper 27, 43 p., illus., tables, 1971.

About 45 percent of the land in Hamilton and York Counties is irrigated with water pumped from wells. Beginning in 1961, a downward trend of water levels indicated the ground-water supply was being depleted progressively. Comparison of water levels in the spring of 1970 with estimated water levels prior to irrigation development indicates a net decrease of nearly 1 million acre-feet in stored supply. Pumpage during the 1969 irrigation season apparently did not contribute significantly to the

long-term net decrease inasmuch as the weighted water-level change between springs of 1969 and 1970 indicated almost no change in ground-water storage. If seasonal water-level declines are proportional to seasonal pumpage, hydrographs of water-level changes since 1958 in 10 wells indicate that 1969 pumpage was much less than in the years 1963-67 when the downward trend of water levels was the steepest. — *from* Author's abstract

01194 **Stehli, Francis G.; Grant, Richard E.** Permian brachiopods from Axel Heiberg Island, Canada, and an index of sampling efficiency: Jour. Paleontology, v. 45, no. 3, p. 502-521, illus., 1971.

A small collection of brachiopods from Svartevaeg, Axel Heiberg Island, lat 81° N., shows the typical low diversity of Arctic (Boreal) Permian faunas. Normally, 16 brachiopod families, termed Cosmopolitan Dominant, can be expected in both Boreal and Tethyan Permian assemblages; deviation from this number is an index of efficiency of reconnaissance collecting. Surprisingly, Boreal localities tend to have been sampled more nearly completely than Tethyan, owing to low diversity of Boreal faunas that reflects lack of the endemic families that make up a large percentage of Tethyan faunas. The Svartevaeg fauna is considered early Guadalupe in age, correlative with Late Permian faunas of east-central Greenland and Svalbard. *Crurithyris aquilonia* and *Paeckelmannella calignea* are new species; *Beecheria* and *Glossothyropsis* are reported for the first time from the Arctic Permian. — REG

08636 **Steinbrugge, Karl V.** Engineering aspects of the Santa Rosa, California, earthquakes, October 1, 1969, *in* The Santa Rosa, California, earthquakes of October 1, 1969: Rockville, Md., U.S. Coast and Geodetic Survey, p. 1-63, illus., tables, 1970.

The Santa Rosa, Calif., earthquakes of October 1, 1969, followed the pattern of moderate-magnitude, shallow-focus earthquakes in that the damaging shocks were only about six miles below ground surface and directly beneath the city and the damage was concentrated in a small, confined area with a rapid dropoff of intensity as a function of distance from the center. Areas of extensive damage were underlain by alluvial soils and young unconsolidated alluvium with a high ground-water level. Ground motion may also have been amplified by reflection from harder adjacent formations. Damage to buildings and public services of various construction and materials is described in detail. A disproportionate amount of damage occurred to newer, earthquake-resistant buildings which complied with existing seismic codes. Recommendations are made for code revisions, installation of strong-motion instruments and coordination of emergency measures for disaster control. — EH

Stermac, A. G. *See* Matich, M. A. J. 01213

Stern, T. W. *See* Anderson, C. A. 01100

Stern, Thomas W. *See* Phair, George. 01345

01392 **Stern, Thomas W.; Phair, George; Newell, Marcia F.** Boulder Creek batholith, Colorado — Pt. 2, Isotopic age of emplacement and morphology of zircon: Geol. Soc. America Bull., v. 82, no. 6, p. 1615-1633, illus., tables, 1971.

Zircon from six rocks which span the range of differentiation in the Boulder Creek batholith yielded a "discordia" age of 1725 m.y. indicating that the constituent rocks are cogenetic. Studies show that 20-80 percent of the zircon in any sample is noneuhedral and, in direct contrast with the associated euhedral zircon, increases in abundance towards contacts with older metasediments; it is inferred to have been "inherited" by assimilation. All zircons fit a single discordia chord indicating that both types formed at about the same time, a conclusion supported by field relations which indicate that the batholithic rocks were emplaced during aperiod of metamorphism. Zircons from cross-cutting Silver Plume rocks gave a discordia age of 1415 m.y. The Silver Plume "thermal event" left no age imprint on the older zircon. — *from* Authors' abstract

08593 **Sternberg, Charles M.** Comments on dinosaurian preservation in the Cretaceous of Alberta and Wyoming [with French abs.]: Canada Natl. Mus. Nat. Sci. Pubs. Palaeontology, no. 4, 9 p., illus., 1970.

Observations are noted on the mode and positions of preservation of hadrosaurs, ceratopsians, and dome-headed dinosaurs (*Stegoceras*) that Sternberg has collected over many years from the Late Cretaceous Oldman and Edmonton Formations of southern Alberta and the Lance Formation of eastern Wyoming. Careful observation of the remains *in situ* may provide considerable information on the appearance of the living animal, manner of death, transportation, and burial, and the environments in which the various forms of dinosaurs lived and died. — VMJ

01051 **Sternberg, Richard W.** Measurements of incipient motion of sediment particles in the marine environment: Marine Geology, v. 10, no. 2, p. 113-119, illus., table, 1971.

A series of measurements of flow conditions and associated sediment motion, in high-velocity tidal channels in Puget Sound, Washington, consisted of velocity distribution occurring within 2 m of the bed, visual observation of the occurrence of incipient grain movement, and time-lapse photography of the seabed. Estimates have been made of mean bottom velocity, shear velocity, and Shield's friction coefficient associated with sediment movement. Results indicate that for mean grain sizes ranging from 0.30 mm to 1.10 mm and a variety of bed configurations, critical values required to initiate general sediment motion agree with experimentally derived competency curves. Bed-load transport of sediment corresponding to the occurrence of general sediment motion for grain sizes approximately 0.40 mm in diameter is estimated to be 8.4×10^{-3} g $cm^{-1}sec^{-1}$. This movement is associated with mean velocity and shear velocity of 38.5 and 2.30 cm/sec, respectively. — Author's abstract

Stevens, P. R. *See* Irwin, J. H. 01182

Stevens, P. R. *See* Akers, J. P. 01296

01354 **Stewart, David P.** Pleistocene mountain glaciation, northern Vermont — Discussion [of paper by W. P. Wagner, 1970]: Geol. Soc. America Bull., v. 82, no. 6, p. 1759-1760, 1971.

For the paper under discussion, *see* ibid., v. 81, no. 8, p. 2465-2478, 1970; Abs. North American Geology, April 1971.

01318 **Stewart, John H.** Basin and Range structure — A system of horsts and grabens produced by deep-seated extension: Geol. Soc. America Bull., v. 82, no. 4, p. 1019-1043, illus., table, 1971.

The shape, composition, and distribution of major valleys and mountain ranges of the Basin and Range province suggest that many or all of them may be complex grabens, and horsts or tilted horsts rather than parts of tilted fault blocks; gravity data tends to confirm this interpretation. The formation of the grabens and horsts can be attributed to fragmentation of a crustal slab above a plastically expanding substratum. The geometry of the causal faulting requires east-west extension estimated to aggregate 30 to 40 mi across the entire Great Basin. Most of this extension has taken place in the last 17 m.y. or even in the last 7 to 11 m.y., indicating extension of 0.3 to 1.5 cm/yr. — WHN

Stokes, W. Lee. *See* Rigby, J. Keith. 01200

01291 **Stone, Richard O.** Special opportunities offered by educational television on a commercial station, *in* Teaching introductory college geology by television — Council on Education in the Geol. Sci. Pub. 6: Washington, D.C., Amer. Geol. Inst., p. 28-29, 1971.

The article discusses special educational applications of the geology segment of the Odyssey Series, a physical geology program produced on television as a joint University of Southern California — Columbia Broadcasting System venture. Besides

university students who took the course for credit, retired people, pre-college students, and members of the Armed Forces of the United States found it a valuable program. — EH

Stradling, Dale. *See* Gilmour, Ernest H. 08528

Stringfield, V. T. *See* LeGrand, H. E. 01286

Stumpfl, E. F. *See* Suensilpong, S. 01233

01233 **Suensilpong, S.; Stumpfl, E. F.** The Nigadoo River base metal deposit, New Brunswick, Canada: Inst. Mining and Metallurgy Trans., v. 80, sec. B. Bull. 774, p. B95-B107, illus., table, 1971.

Structural, mineralogical, and petrological studies are combined to elucidate the genesis of the Nigadoo River Pb-Zn-Cu orebody and its position within the Acadian orogeny. Distinct mineral associations occur in the three structurally defined vein types. Most of the ore reserves, > 1,000,000 tons, are contained in a NW-SE striking vein system (type 2), which cuts both the synorogenic Nigadoo porphyry and isoclinally folded Silurian argillites. Type 2 veins carry products of two cycles of mineralization; moreover, minerals of veins in the porphyry differ from those in sediments, the former including iron-rich indium-bearing sphalerite, hexagonal pyrrhotite, and troilite, and the latter various sulfosalts and dyscrasite. The mineralogical pattern indicates that the porphyry had not cooled completely when mineralization commenced. Hydrothermal solutions either emanated from a deep granitic source or from remobilized older (Bathurst-type?) deposits. — VMJ

00992 **Summers, W. K.; Ross, Sylvia H.** Geothermics in North America, present and future: Earth Sci. Bull., v. 4, no. 1, p. 7-22, illus., 1971.

Electrical power from natural steam has proven to be an economic source of energy in western North America. Power plants are now in operation in California and in Mexico, and development is continuing in these areas as well as in Central America. Most parts of western United States are being considered for exploration. Techniques used in exploration include geologic mapping, fluid dynamics studies, and physical and chemical measurements, in addition to test drilling. New suggestions for development include a heat-exchange process that uses super-heated water instead of steam and various types of nuclear stimulation. Passage of the Federal Geothermal Steam Act of 1970 and increasing needs for electrical power should be the incentives that will make 1971 a major year for geothermal exploration. — Authors' abstract

08575 **Sumsion, Carlton T.** Geology and ground-water resources of Pitt County, North Carolina: North Carolina Div. Ground Water Ground Water Bull., no. 18, 75 p., illus., tables, 1970.

Pitt County, comprising 656 sq mi in the coastal plain of eastern North Carolina, is characterized by nearly flat-lying surficial sediments of Holocene and Tertiary age overlying Cretaceous strata which dip gently southeast. The sediments overlie the irregular surface of a southeastward sloping basement complex of granitic and metamorphic rocks. Ground water occurs in seven major aquifers, five of which underlie only part of the county and two of which underlie the entire county. Large quantities of water for industrial or municipal supplies are obtained from artesian aquifers tapped by drilled wells; current withdrawal is only a small percentage of recharge. Water in the shallow unconfined aquifer is slightly acidic, often with objectionable amounts of iron; most farm water supplies are from these aquifers. In the eastern part, brackish or saline water is present in deeper confined Cretaceous aquifers. — VSN

Swanson, D. A. *See* Shaw, H. R. 08545

Swanson, D. A. *See* Shaw, H. R. 08643

01377 **Swanson, Donald A.; Jackson, Dallas B.; Duffield, Wendell A.; Peterson, Donald W.** Mauna Ulu eruption, Kilauea Volcano: Geotimes, v. 16, no. 5, p. 12-16, illus., 1971.

The Mauna Ulu eruption which began on May 24, 1969, is the longest and most voluminous flank eruption in the recorded history of Kilauea Volcano. Mauna Ulu is a broad new spatter-and-lava shield being built over an active vent on Kilauea's east rift and is about 2 km long, 1 km wide, and 100 m high. Lava from this and associated vents has covered about 45 km² on the south flank of Kilauea; total volume erupted as of April 1, 1971, is 150-175 million m³. Significant features of the eruption described here include forerunner events, chronology of activity, effects on Alae Crater, nature of the lava, and ground deformation. — VSN

08509 **Sweet, Walter C.; Bergstrom, Stig M.** The generic concept in conodont taxonomy, *in* The genus, a basic concept in paleontology — North Am. Paleont. Convention, Chicago, Ill., 1969, Proc., Pt. C: Lawrence, Kans., Allen Press, p. 157-173, illus., 1970.

There have been two generic concepts for conodonts, the form genus and the multielement genus. "Natural assemblages" are convincing evidence that the skeletal apparatus of at least some conodonts consisted of several types of elements of different morphology. Form species groups can be interpreted as species and grouped into genera. Major structural plans will probably serve as models for suprageneric categories at several levels. The multielement concept of conodont genera and species will almost certainly come to be widely held in the next decade, the only major impediment now to its wide application is reluctance to provoke the short but inevitable period of nomenclatural chaos produced by a change in taxonomic philosophy. — DBV

08611 **Switzer, Paul.** Numerical classification, *in* Geostatistics — A colloquium (D. F. Merriam, editor), Lawrence, Kan., 1970, Proc.: New York, Plenum Press, p. 31-43, illus., 1970.

The first section briefly reviews the rationales and some shortcomings of commonly used techniques for sorting [geologic] samples into homogeneous classes. The second section suggests that computer screening of large numbers of differently oriented data projections may provide useful insights into configuration of the samples. — Author's abstract

Syers, J. K. *See* Shukla, S. S. 01276

Syers, J. K. *See* Williams, J. D. H. 01277

Sykes, Lynn R. *See* Molnar, Peter. 01327

Szabo, Michael W. *See* Clarke, Otis M., Jr. 08678

08487 **Tabor, Guy F., Jr.** Problem soils in Colorado, a summary, *in* Governor's Conf. on Environmental Geology: Colorado Geol. Survey Spec. Pub., no. 1, p. 53-54 [1970?].

Of the many soil types in Colorado, a few are outstanding in the problems they can cause if their characteristics are not properly taken into account in design. Their locations can be given in general terms, but actual conditions must be studied in detail to provide significant engineering information for a specific type of construction. The critical soil types include swelling clays; fine-grained low-density soils, usually silty; loose sand; and man-made fills. — DBV

Takahashi, Taro. *See* Ahrens, Thomas J. 01132

01091 **Takasaki, Kiyoshi J.** Ground water in the Waianae District, Oahu, Hawaii: U.S. Geol. Survey Hydrol. Inv. Atlas HA-358, 2 sheets, scale 1:62,500, text, geol. map, 1971.

Talley, John H. *See* Morse, S. A. 01043

Tanner, Roy G. *See* Conlon, Robert J. 01215

01231 **Tanner, William F.** Net kinetic energy in littoral transport: Science, v. 172, no. 3989, p. 1231-1232, 1971.

Studies of coastal erosion and coastal management can be put on a firm physical basis only after methods have been developed for closely estimating the energy expended in actual unidirectional net littoral transport of sediment. Such measures have now been obtained for six coastal drift cells. The results, for a 68-year period, vary from a minimum of 0.6×10^4 ergs (very low energy) to a maximum of 340×10^4 ergs (moderately high energy) per cell. — Author's abstract

08533 **Taubeneck, William H.** Dikes of Columbia River Basalt in northeastern Oregon, western Idaho, and southeastern Washington, *in* Columbia River Basalt Symposium, 2nd, Cheney, Wash., 1969, Proc.: Cheney, Eastern Washington State College Press, p. 73-96, illus., tables, 1970.

Dikes of the Chief Joseph swarm, major feeders for the Columbia River Basalt, are exposed for at least 165 miles in the area in question. At least 21,000 are conservatively estimated to occur at the level of regional unconformity beneath the Columbia River Basalt. Trends of the dike swarms suggest that the Columbia River Basalt reached the surface as a result of the same tectonic forces that prevailed throughout the Basin and Range structural province. The trends do not favor post-Miocene oroclinal bending in the eastern part of the Columbia Arc. — DBV

01021 **Taylor, Alfred R.; Lewis, Richard Q., Sr.** Geologic map of the Liberty quadrangle, Casey County, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-946, scale 1:24,000, section, text, 1971.

01401 **Taylor, Alfred R.; Lewis, Richard Q., Sr.** Geologic map of the Yosemite quadrangle, Casey and Lincoln Counties, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-910, scale 1:24,000, sections, text, 1971.

01400 **Taylor, F. C.** A revision of Precambrian structural provinces in northeastern Quebec and northern Labrador: Canadian Jour. Earth Sci., v. 8, no. 5, p. 572-579, illus., table, 1971.

On the basis of recent mapping, the following revisions of structural provinces in the area in question are recommended: Almost all of the area known as the Western Nain subprovince should be classed as part of the Churchill province that was later isotopically overprinted; the Eastern Nain subprovince should become the Nain structural province; and this new Nain province should be extended southward to include a wedge-shaped area, designated the Makkovik subprovince, formerly considered to be part of the Grenville province. — DBV

Taylor, Hugh P., Jr. *See* Turi, Bruno. 01071

01034 **Taylor, P. T.; Hekinian, R.** Geology of a newly discovered seamount in the New England seamount chain: Earth and Planetary Sci. Letters, v. 11, no. 2, p. 73-82, illus., tables, 1971.

A recently discovered seamount in the New England seamount chain, the [twin-peaked] Gilliss Seamount, was selected for a detailed geological and geophysical study. From seismic profiler data it was noticed that two distinct acoustic patterns are present in the immediate vicinity of the seamount, one transparent, the other highly layered. Analysis of piston cores indicated the presence of foraminiferal ooze which could be related with the transparent acoustic pattern and turbidites representing the highly layered seismic pattern. Petrological and chemical studies of rock dredged from the seamount revealed the presence of extremely altered pillow lava fragments of basaltic composition. — Authors' abstract

01283 **Taylor, Ronald S.** Petrology and micropaleontology of Ordovician rocks in central Alabama: Southeastern Geology, v. 12, no. 4, p. 267-277, illus., 1971.

Variations in grain types, degrees of grain packing, microfossil assemblages and primary sedimentary structures are criteria for recognizing depositional environments of three Ordovician units in central Alabama. Sediments of these sections are interpreted as tidal flat (Newala Limestone), below wave base open-shelf (Little Oak Limestone), and above wave base open-shelf (Chickamauga Limestone, Unit III) deposits. The diversity of ostracodes and presence of abundant sponge spicules aid in recognizing depositional environments. Major lithotypes are: unfossiliferous carbonate mudstone, intraclastic-pelletal packstones, fossil-bearing burrowed wackestones, and sheet-stratified skeletal lime packstones and grainstones. — VSN

08484 **TenEyck, Thomas W.** Natural resources — Their protection, utilization and conservation, *in* Governor's Conf. on Environmental Geology: Colorado Geol. Survey Spec. Pub., no. 1, p. 29-32 [1970?].

Resources which are renewable within limits are land, forests, water, and wildlife. Nonrenewable resources, such as the minerals, will require everything possible in the way of salvage and reuse. Renewable and nonrenewable resources require different policies. Since the environment is physically limited, there is need to consider and develop the concept of multiple use of resources. Ways must be found to permit utilization of minerals without spoiling the entire countryside, and harvesting timber so as not to encourage erosion; we have to change our criteria. — DBV

Thode, H. G. *See* Grinenko, V. A. 08703

08551 **Thompson, Allan M.** Tidal-flat deposition and early dolomitization in Upper Ordovician rocks of southern Appalachian Valley and Ridge: Jour. Sed. Petrology, v. 40, no. 4, p. 1271-1286, illus., 1970.

Beds of dolomite-rich carbonate occur in rocks transitional between Juniata and Sequatchie Formations. Gray biomicrites and biomicrudites of Sequatchie facies represent offshore-subtidal deposition; they show periodic scouring and are not visibly burrowed or desiccated. Juniata facies are red, silty and clayey, pelletal dolomicrites and dolomitic shales, and with evidence of desiccation and scouring. An infaunal element produced isolated, vertical burrow structures. Juniata facies represent deposition on high tidal flats, flooded only occasionally. Rocks intermediate between Sequatchie and Juniata facies contain vertical and horizontal burrow structures, are extensively bioturbated and mottled, and represent deposition on low tidal flats to very shallow-subtidal, nearshore zones. Dolomite is more abundant in supratidal rocks and formed on high tidal flats by precipitation from evaporating pore waters trapped after floodings. — *from* Author's abstract

Thorud, David B. *See* Simpson, E. S. 08432

Thurber, David. *See* Habib, Daniel. 08521

01123 **Tilton, G. R.** Radioactive and radiogenic isotope research, *in* Volcanology, Geochemistry and Petrology, U.S. National Report, 1967-1971, Fifteenth General Assembly, IUGG: EOS, v. 52, no. 5, p. IUGG 100-105, 1971.

This is a summary and bibliography of papers on the more significant or more complete isotopic investigations, published by U.S. laboratories from approximately January 1967 through October 1970. — DBV

Tobin, Don G. *See* Donath, Fred A. 01338

01339 **Tobin, Don G.; Donath, Fred A.** Microscopic criteria for defining deformational modes in rock: Geol. Soc. America Bull., v. 82, no. 6, p. 1463-1476, illus., tables, 1971.

Microscopic effects of deformation in experimentally deformed oölitic limestone samples were categorized and subjected to multivariate analysis. The results reveal four groups of microscopic features which can be used as criteria to define the macroscopic deformational mode of the samples. — AG

01005 **Tobisch, Othmar T.; Turner, Mort D.** Geologic map of the San Sebastian quadrangle, Puerto Rico: U.S. Geol. Survey Misc. Geol. Inv. Map I-661, scale 1:20,000, sections, text, 1971.

01381 **Tokarsky, O.** Hydrogeology of the Grimshaw-Chinook Valley area, Alberta: Research Council Alberta Rept. 71-2, 19 p., tables, geol. map, 1971.

The hydrogeological map with this report includes: topography, geology, groundwater probability, water levels, hydrochemistry, springs. The main aquifers are near-surface Grimshaw gravels, which may yield over 100 imperial gpm; and sandstone lenses in the Upper Cretaceous Dunvegan Formation, yield of which at any one point may range from 25 to 100 igpm. Water quality is good within the gravels, dissolved solids averaging 500 mg per liter, and variable within the Dunvegan Formation ranging from less than 500 mg/l in recharge areas to over 4000 mg/l in discharge areas. More locally used aquifers include sand and gravel lenses in drift. Potential yield of sands and gravels near base of a buried channel 500 to 800 feet below ground level has not yet been tested. Calculations indicate natural recharge rate of 1.2 to 1.9 inches per year. — *from* Author's abstract

01262 **Tolbert, Al; Ayres, George; Helm, Gay.** Roger Wesley Bryan (1927-1971): Houston Geol. Soc. Bull., v. 13, no. 10, p. 23-25, portrait, 1971.

08552 **Toomey, Donald Francis.** An unhurried look at a Lower Ordovician mound horizon, southern Franklin Mountains, West Texas: Jour. Sed. Petrology, v. 40, no. 4, p. 1318-1334, illus., tables, 1970.

Relatively small-scale carbonate mounds are best developed in the McKelligon Canyon Formation of the Lower Ordovician El Paso Group, and the largest mound, Lechuguilla, is examined in detail. Three growth stages are: (1) establishment of a poineer colony, (2) development into a mature biotic entity, and (3) development of a climax community. The sequence may reflect a response to organism requirements with increasingly shallower depositional environments. Some mounds are eroded and filled with skeletal debris, reflecting subaerial exposure, related to sea level changes. The Texas mounds closely resemble the Chazyan mounds of New York and Vermont in gross morphology, petrology, and basic biotic composition and sequence, although there are important temporal biotic differences when evolutionarily more advanced organisms occupied similar mound niches. — HRC

01274 **Topp, G. C.** Soil-water hysteresis — The domain theory extended to pore interaction conditions: Soil Sci. Soc. America Proc., v. 35, no. 2, p. 219-225, illus., 1971.

In the extension of the domain theory discussed here, the draining and filling of each pore in soil is assumed to depend on the state of neighboring pores as well as the pore geometry. Ratios of changes in water content of soil during drying and rewetting over a given pressure head range were used to determine the importance of pore interactions and to separate the two types of pore blockage. Primary scanning curve data for porous materials (glass beads to clay loam soil) showed that pore blockage against air-entry during drying of a soil near saturation and pore blockage against water-entry during rewetting of a dry soil were the two major types of pore interactions. The degree of blockage appeared to be dependent only on water content of the soil. — *from* Author's abstract

Towe, K. M. *See* Malone, Ph. G. 08658

Tremblay, L. P. *See* Fraser, J. A. 08662

Tremblay, L. P. *See* Fraser, J. A. 08664

Trimble, D. E. *See* Crittenden, Max D., Jr. 01161

08618 **Tukey, John W.** Some further inputs, *in* Geostatistics — A colloquium (D. F. Merriam, editor), Lawrence, Kan., 1970, Proc.: New York, Plenum Press, p. 163-174, illus., 1970.

This presentation is an attempt to respond, in real time (which means unprepared) to the themes and problems of the Colloquium on Geostatistics in terms of the current state of the arts of data analysis, spectrum analysis, and classical statistics. I would like to comment on several subjects, including rootograms, east squares, spectra, means and variances, the jackknife, and 2-dimensional schematic plots. — Author's abstract

01033 **Turekian, Karl K.** Marine geochemistry, *in* U.S. National Report, 1967-1971, Fifteenth General Assembly, IUGG, — Oceanography: EOS, v. 52, no. 6, p. IUGG 237-244, 1971.

During 1967 through 1970 the major trends in marine geochemistry were: (1) intercalibration of radioactive, "chemical," and magnetic dating techniques in deep-sea sediments; (2) improvement in understanding of major chemical controls on composition of sea water and sediments including the carbon dioxide-calcium carbonate system; (3) more refined application of U and Th decay series nuclides to ocean circulation problems; (4) improvement of reliability of trace element analyses on natural waters; and (5) study of sources and chemical properties of detrital deep-sea deposits using isotopic, mineralogic, and chemical data. Several major projects contributed to the intensification of large-scale and cooperative programs. Work done on sea water composition, geochronometry of marine deposits, and geochemistry of marine deposits is systematized and keyed to a 4 1/2-page bibliography. — DBV

01071 **Turi, Bruno; Taylor, Hugh P., Jr.** An oxygen and hydrogen isotope study of a granodiorite pluton from the Southern California batholith: Geochim. et Cosmochim. Acta, v. 35, no. 4, p. 383-406, illus., tables, 1971.

The uniform whole-rock δ O-18 = + 7.24 ± 0.11 of the core zone of the Demenigoni Valley granodiorite pluton, interpreted as approximately that of the original magma, is abnormally depleted in O-18 relative to the major granodiorites and quartz monzonites of the Southern California batholith. This and field relations thus suggest that the pluton is more closely related to the major tonalites and gabbros of the batholith. The body was intruded into high O-18 metasediments, with strong oxygen isotopic interaction between the granodiorite and metasediments. The hydrogen isotope ratios are uniform throughout the granodiorite and identical to that of biotite in the metasediments. These isotopic effects are not accompanied by significant chemical and mineralogical effects and thus cannot be explained by assimilation of the country rocks. The isotopic data are consistent with petrographic evidence of recrystallization in the granodiorite. — DBV

Turner, Mort D. *See* Tobisch, Othmar T. 01005

01024 **Upson, Joseph E.** Surficial geologic map of the Mystic quadrangle, Connecticut, New York, and Rhode Island: U.S. Geol. Survey Geol. Quad. Map GQ-940, scale 1:24,000, text, 1971.

Urban, James B. *See* Engman, Edwin T. 01374

01254 **Urey, Harold C.; MacDonald, Gordon J. J.** Origin and history of the Moon, *in* Physics and astronomy of the Moon, 2d edition (Zdenek Kopal, editor): New York and London, Academic Press, p. 213-289, illus., tables, 1971.

Interpretation of recent investigations of the Moon indicates that it accumulated at low temperatures with local or temporary melting only, and that it has had a high rigidity since formation. Surface features formed over a short period very early in Moon history are the result of collisions of objects with the surface; melting, ash flows, or dust clouds are from these collisions and not from subsurface melting. The genesis of smooth areas of the Moon cannot be understood until more information is accumulated. The basaltic character of material in the maria and terrae indicates partial melting or fractional crystallization of primitive materials and is not easily reconciled with other data. The high gas content of dust indicates this material has been on the Moon's surface probably a billion or more years. — VSN

00998 **U.S. Geological Survey.** Aeromagnetic map of part of the Ragged Top Mountain quadrangle, Albany and Laramie Counties, Wyoming: U.S. Geol. Survey Geophys. Inv. Map GP-410, scale 1:62,500, 1971.

00999 **U.S. Geological Survey.** Aeromagnetic map of parts of the Tonopah and Millet 1° by 2° quadrangles, Nevada: U.S. Geol. Survey Geophys. Inv. Map GP-752, scale 1:250,000, 1971.

01000 **U.S. Geological Survey.** Aeromagnetic map of part of Cecil County, Maryland, and parts of adjacent counties in Maryland and Delaware: U.S. Geol. Survey Geophys. Inv. Map GP-755, scale 1:62,500, 1971.

01001 **U.S. Geological Survey.** Aeromagnetic map of part of Kent County, Maryland, and parts of adjacent counties in Maryland and Delaware: U.S. Geol. Survey Geophys. Inv. Map GP-756, scale 1:62,500, 1971.

01002 **U.S. Geological Survey.** Aeromagnetic map of part of the Scituate quadrangle, Plymouth County, Massachusetts: U.S. Geol. Survey Geophys. Inv. Map GP-767, 1971.

01087 **U.S. Geological Survey.** (Branch of Mineral Classification, compiler). Reported occurrences of selected minerals in Colorado: U.S. Geol. Survey Mineral Inv. Resource Map MR-57, scale 1:500,000, 1971.

01202 **Valentine, James W.** How many "fossilizable" species of Sarcodina?—A new fallacy: Jour. Paleontology, v. 45, no. 3, p. 555-556, 1971.

The number of "fossilizable" species of Sarcodina (chiefly Foraminifera and Radiolaria) was overestimated by Valentine (ibid., v. 44, no. 3, 1970). This does not materially affect the broad estimates made of total Phanerozoic marine invertebrate species. — RCD

Vallely, James L. *See* O'Neill, James F. 08578

01340 **VanAndel, Tjeerd H.; Heath, G. Ross; Malfait, Bruce T.; Heinrichs, Donald F.; Ewing, John I.** Tectonics of the Panama Basin, eastern equatorial Pacific: Geol. Soc. America Bull., v. 82, no. 6, p. 1489-1508, illus., 1971.

The Panama Basin includes portions of the Nazca, Cocos and South America lithospheric plates and borders the Caribbean plate. The topographic basin appears to have been created by rifting of an ancestral Carnegie Ridge. As blocks of the Cocos Ridge reach the Middle America Trench, they appear to clog the subduction zone and become welded to the Nazca plate. Thus, the active transform fault at the eastern edge of the Cocos plate has episodically shifted west as segments of the trench were deactivated. Such a shift appears to be occurring at the present time. — *from* Authors' abstract

08462 **VanAtta, Robert E.** Device for field determination of heavy metals in natural waters: Illinois Univ. Water Resources Center Research Rept., no. 35, 28 p., illus., tables, 1970.

Results are described of a project to develop and test a simple, portable, self-contained device for in situ analysis of natural waters, primarily for Cu, Pb, Cd, Ni, Cr, and Zn. The prototype model finally constructed and field tested (Model II) uses a dropping mercury electrode and trisodium citrate as an electrolyte. Circuitry is illustrated in figures; the design adopted consists of six individual circuits. The analytical procedure, including sampling, solution preparation, instrument operating procedure, and the results of tests, is discussed. — VSN

08518 **VanValen, Leigh.** Late Pleistocene extinctions, *in* Evolution of communities — North Am. Paleont. Convention, Chicago, Ill., 1969, Proc., Pt. E: Lawrence, Kans., Allen Press, p. 469-485, table, 1970.

Two general explanations have been offered for the late Pleistocene extinction of many—perhaps most—of the large species of terrestrial vertebrates. One implicates man, the other invokes unusually severe climatic changes. Neither side has adequately dealt with the most important evidence for the other side, resulting in a plethora of individually plausible but jointly contradictory arguments. This paper isolates and evaluates the relevant arguments, and indicates the major unresolved points. No one set of arguments seems at all conclusive when taken in conjunction with other available evidence. Solution to the problem will require more evidence at crucial places indicated, or arguments not yet raised. — DBV

01070 **Vaughan, David J.; Burns, Roger G.; Burns, Virginia Mee.** Geochemistry and bonding of thiospinel minerals: Geochim. et Cosmochim. Acta, v. 35, no. 4, p. 365-381, illus., tables, 1971.

This paper illustrates how the crystal chemistry, geochemistry, and certain physical properties of thiospinel minerals may be interpreted by molecular orbital and band theories of the chemical bond. In the spinel structure, transition metal ions occur in tetrahedral and octahedral coordinations, and 3d electrons of cations bonded to sulfur atoms are distributed among non-bonding and anti-bonding molecular orbitals. The composition ranges, geochemistry, and variations of cell parameters, microhardness, reflectivities, and relative stabilities of the thiospinels are directly related to the numbers of electrons in antibonding molecular orbitals. The preference of transition metal ions for octahedral coordination is reflected by the ease of which thiospinel phases transform to a cation defect NiAs structure at elevated pressures and temperatures. As a result, polymorphic transitions involving thiospinel phases are postulated in the mantle and in shocked meteorites. — DBV

01191 **Vaughn, Peter Paul.** A *Platyhystrix*-like amphibian with fused vertebrae, from the Upper Pennsylvanian of Ohio: Jour. Paleontology, v. 45, no. 3, p. 464-469, illus., 1971.

Coalesced neural arches and parts of coalesced neural spines of a dissorophoid labyrinthodont amphibian found in the Conemaugh Group in eastern Ohio are designated as the holotype of *Astreptorhachis ohioensis*, new genus and species. Except that their distal protions are fused together and that they were probably only about half as long, the tuberculated spines are closely similar to those of the 'sail' of the long-spined Early Permian rhachitome *Platyhystrix rugosus*. The relatively shorter dorsal part of the vertebral column of *P. rugosus* was probably fairly stiff; that of *A. ohioensis* must have been in large part inflexible. Perhaps these features were associated with increased terrestriality.—*from* Author's abstract

08515 **Vaughn, Peter Paul.** Lower Permian vertebrates of the Four Corners and the Midcontinent as indices of climatic differences, *in* Paleoclimatology — North Am. Paleont. Convention, Chicago, Ill., 1969, Proc., Pt. D: Lawrence, Kans., Allen Press, p. 388-408, illus., 1970.

Data now available permit an analysis of distributions of Early Permian vertebrate faunas of the southwestern United States and their correlations with lithology, floral associations, and paleogeographic data. This paper concentrates on general patterns indicated by the distributions and elaborates on a climatological theory suggested in a 1969 paper which may help explain certain aspects of those patterns (namely, that the ancestral Rocky Mountains cast a rain shadow over parts of the Four Corners). In addition, refinement of an analysis of the distribution of sphenacodontine pelycosaurian reptiles is attempted. — DBV

01046 **Veeh, H. Herbert; Boström, Kurt.** Anomalous U-234/U-238 on the East Pacific Rise: Earth and Planetary Sci. Letters, v. 10, no. 3, p. 372-374, illus., table, 1971.

Data on U and Th isotopes in sediments and iron deposits on the East Pacific Rise indicate that sea water is the source of most uranium in the sediments. U-234/U-238 ratios are higher than unity and approach the oceanic value of 1.15 in sediment surface samples from the crest, or similar to heavy metal deposits in the Red Sea geothermal area. Th-232 contents, Th/U, U/Fe and Th-230/U-234 ratios occupy an

intermediate position between ordinary pelagic clays and the Red Sea deposits. An anomalously high U-234/U-238 ratio in an iron deposit sample from a seamount on the Rise crest could be related to fractionation of uranium isotopes during volcanic processes or to preferential leaching of U-234 from wall rocks by ascending hydrothermal fluids associated with volcanism. — VSN

08527 **Velasco Hernández, Juan.** Levantamiento gravimétrico zona geotérmica de Mexicali, Baja California [Gravimetric survey of the Mexicali geothermal zone, Baja California]: México Consejo Recursos Nat. no Renovables Bol. 74, 19 p., illus., 1970.

Data from a gravimetric survey of the Mexicali geothermal zone indicate the presence of two large, sunken blocks of crystalline rock adjacent to the Sierra de Cucapas, bounded by large faults and covered by Cenozoic sedimentary rocks. The deepest block is directly below the most important geothermal surface expressions. Three profiles were constructed which compare the observed anomaly with that calculated for certain hypothetical conditions but compatible with known geological and geophysical data. After data reduction and consultation with H. Alonso, it was assumed that the wells drilled near the gravimetric profile confirm the depth of the crystalline basement, calculated by geophysical interpretation. — *from* Author's summary

01093 **Venkitasubramanyan, C. S.** Qualitative analysis of three-dimensional strain using twins in calcite and colomite: Tectonophysics, v. 11, no. 3, p. 217-231, illus., 1971.

Turner's (1953) technique of locating compression (C) and tension (T) axes from known orientations of C-axis and twin pole — [02$\bar{2}$1] in dolomite and [01$\bar{1}$2] in calcite — for each grain yields orientation of the unique stress system when a great majority of the grains in the rock shows only singlet twins. Since it assumes the highest possible value for the coefficient of resolved shear stress $S_0(=0.5)$, its application to rocks in which many grains show doublet and triplet twins results in great dispersion of the C- and T-axes. In such cases the unique stress system can be established by preparing separate C-axes fabric diagrams for the untwinned grains, and grains with singlet, doublet, or triplet twins; measurement of orientations of twin planes becomes unnecessary. Two examples are presented. The significance of the appearance of 'conjugate twin planes' is discussed. — *from* Author's abstract

01337 **Venkitasubramanyan, C. S.** Least-squares analysis of fabric data — A note on conical, cylindroidal and near-cylindroidal folds [with French abs.]: Canadian Jour. Earth Sci., v. 8, no. 6, p. 694-697, illus., 1971.

A cylinder and a plane may be considered as special limiting cases for a right circular cone as the semi-apical angle approaches 0° and 90°, respectively. If these forms are viewed as surfaces generated by an array of lines in space, the rotation axis for the array can be determined from the orientations of the surface-generating lines by a single computational procedure, using least-squares criterion. The mean angle between rotation axis and surface-generating lines will be the semi-apical angle of the cone. If this method is extended to fabric diagrams, in which an array of lines may only statistically describe a great circle or small circle on a stereographic projection, ambiguities arise in certain cases, and the semi-apical angle obtained may not be the true semi-apical angle because the poles to foliation surfaces are arbitrarily assigned 'senses.' — *from* Author's abstract

Viswanathan, S. *See* Sims, P. K. 08587

01165 **Vitaliano, Charles J.; Vitaliano, Dorothy B.** Gravity waves in the 1954 Fallon, Nevada, earthquake: Seismol. Soc. America Bull., v. 61, no. 2, p. 479, 1971.

This is a report of visible waves in the ground, observed in the vicinity of the epicenter of a magnitude 6.8 shock which occurred at 3:08 p.m. on July 6, 1954, near Fallon, Nevada. Vertical displacement was clearly evinced by relative motion of the opposite sides of an irrigation ditch; the period of oscillation was of the order of a very few seconds. — DBV

Vitaliano, Dorothy B. *See* Vitaliano, Charles J. 01165

Vogel, D. E. *See* Garlick, G. D. 01227

01332 **Vogely, William A.** The future of mineral supplies, *in* Council of Economics, Proc., [V. 6] — AIMMPE, Ann. Mtg., New York, 1971 [Papers]: [New York] Am. Inst. Mining, Metallurgical and Petroleum Engineers, p. 21-28, 1971.

The author states that the future demand for minerals is dependent upon future population growth, income growth, and user technology, with the probability that the first two will decline and the latter will become more efficient. Due to increasing finding and production costs in the mineral industry, recycling of materials will increase, and demand for new mineral production will decrease sharply. — EH

Vogt, P. R. *See* Heirtzler, J. R. 01145

Vogt, Peter R. *See* Bracey, Dewey R. 01328

Vokes, Emily H. *See* Vokes, Harold E. 01242

01242 **Vokes, Harold E.; Vokes, Emily H.** Alabama's Little Stave Creek: Earth Sci., v. 24, no. 2, p. 64-68, illus., 1971.

In the canyon cut by Little Stave Creek is exposed the longest continuous section of Gulf Coast Tertiary strata yet to be found. Walking down the creek the sequence from the upper Oligocene Marianna Limestone to the lower middle Eocene Tallahatta Formation may be examined. Below this the Jackson fault brings the Miocene Chickasawhay Formation into contact with the Eocene Tallahatta. — ESL

01117 **Voorhies, M. R.** The Watkins quarry — A new Late Pleistocene mammal locality in Glynn County, Georgia [abs.]: Georgia Acad. Sci. Bull., v. 29, no. 2, p. 128, 1971.

08563 **Voorhies, M. R.** Sampling difficulties in reconstructing late Tertiary mammalian communities, *in* Evolution of communities — North Am. Paleont. Convention, Chicago, Ill., 1969, Proc., Pt. E: Lawrence, Kans., Allen Press, p. 454-468, illus., 1970.

This paper discusses methods which have been proposed for reconstructing mammalian communities from fragments. Any method which does not include a study of taphonomy is doomed to failure; once a fossil is out of the rock, at least half of the critical clues to the death and burial of individual fossil animals are gone. Probably the most reliable community reconstructions are those based on collections from thin but widespread floodplain deposits of relatively uniform lithology. Examples from late Cenozoic deposits illustrate criteria for recognizing autochthonous but disturbed burials. Harder to interpret are quarriable concentrations of bone, common in the later Tertiary. Shotwell's (1955, 1958, 1963) method of resolving some of the difficulties posed by these mixed faunas is described. Another line of evidence is the age structure of the samples. — DBV

Wada, Ronald N. *See* Williams, John A. 08596

01355 **Wagner, W. Philip.** Pleistocene mountain glaciation, northern Vermont — Reply [to discussion by D. P. Stewart, of 1970 paper]: Geol. Soc. America Bull., v. 82, no. 6, p. 1761-1762, 1971.

For the paper under discussion, *see* ibid., v. 81, no. 8, p. 2465-2478, 1970; Abs. North American Geology, April 1971; discussion, ibid., v. 82, no. 8, p. 1759-60.

01053 **Walt, James R.** Electromagnetic induction technique for locating a buried source: IEEE Trans. Geosci. Electronics, v. GE-9, no. 2, p. 95-98, illus., 1971.

The field structure of a buried vertical oscillating magnetic dipole is examined. For an observer on the Earth's surface, it is indicated that the finite conductivity of the Earth will modify the geometrical character of the vertical and horizontal magnetic

field components. However, this effect is quite small if the burial depth is less than an electrical skin depth. — Author's abstract

Waite, W. P. *See* MacDonald, H. C. 01055

Waite, William P. *See* Macdonald, Harold C. 01067

Wakat, M. A. *See* Corey, J. C. 01273

08622 **Walker, George W.** Some comparisons of basalts of southeast Oregon with those of the Columbia River Basin Group, *in* Columbia River Basalt Symposium, 2nd, Cheney, Wash., 1969, Proc.: Cheney, Eastern Washington State College Press, p. 223-237, illus., table, 1970.

Several major prisms of basaltic rock in southeastern Oregon are about the same age as parts of the Columbia River Group, on the basis of dating by fossils and by the K-Ar method. The northeastern Oregon basalts of comparable age are divisible into an older, middle, and late Miocene group (mostly 15-16 m.y. old) and a younger less precisely dated group more than 9 m.y. old, of early Pliocene and possibly latest Miocene age. The two groups may overlap in time. Each group includes both silica-saturated and -unsaturated petrochemical types. In contrast to the tholeiitic Columbia River Group, the southeastern Oregon basalts are alkali olivine basalt, with some nonporphyritic high-alumina basalt. Most contain normative olivine and hypersthene, and some have small amounts of normative quartz. High-alumina diktytaxitic olivine basalts are present, but are not as common as in younger rocks. — DBV

08667 **Walker, H. J.** Some aspects of erosion and sedimentation in an arctic delta during breakup [with French abs.], *in* Symposium on the Hydrology of Deltas, V. 1: Internat. Assoc. Sci. Hydrology-Unesco Pub. 90, p. 209-219, illus., discussion, 1970.

In arctic deltas, the character and amount of erosion and sedimentation are affected by numerous factors not normally operating in other deltas; a long period of snow and ice cover, continuous permafrost, a thin active layer and extreme variation in discharge are among some of the more important conditions involved. The Colville River, which drains much of arctic Alaska, has nearly half of its discharge and some three-fourths of its sediment load concentrated into the three- to four-week period accompanying and immediately following breakup. During this period thermoerosional niches form in the frozen riverbanks. This undercutting is frequently responsible for bank collapse and rapid bank retreat. Likewise, the bulk of the delta's deposition occurs during this short period of time. As sediment is deposited on bottom-fast river ice and on the sea at the front of the delta, much of it is often lost to the delta during breakup. — Author's abstract

Wallace, Alfred T. *See* Abegglen, Donn E. 08463

Wallace, Alfred T. *See* Williams, Roy E. 08585

Wallis, R. H. *See* Money, P. L. 08631

01078 **Walsh, J. B.; Decker, R. W.** Surface deformation associated with volcanism: Jour. Geophys. Research, v. 76, no. 14, p. 3291-3302, illus., 1971.

Changes in pressure of magma or intrusion into new passages causes the surface of the Earth to deform. Vertical and horizontal displacements measured at Kilauea Volcano in Hawaii are characteristic of those produced by a change in pressure of magma in a vertical column extending upward from depth to a point about 1.5 km below the center of uplift. Theoretical solutions for a line source of dilatation in a half-space show that surface displacements are not sensitive to small changes in the angle of dip. Also, several radially symmetric sources produce similar surface deformation fields, and so careful measurement of the complete field is necessary in order to make reliable estimates of the configuration of the source. — Authors' abstract

01089 **Wanek, Alexander A.; Callahan, James E.** Geologic reconnaissance of a proposed powersite at Lake Grace, Revillagigedo Island, southeastern Alaska: U.S. Geol. Survey Bull. 1211-E, p. E1-E24, illus., tables, geol. map, 1971.

The proposed Lake Grace powersite, in Grace Creek Canyon below Lake Grace, is 32 mi northeast of Ketchikan on the east side of Revillagigedo Island, Alaska, in a mountainous, glaciated region within the Coastal Foothills section of the Coast Mts. province. The site is underlain by a complex zone of intrusive and metamorphic rocks bordering the composite Coast Range batholith; quartz diorite, diorite gneiss, and lesser amounts of diorite and granodiorite are exposed. Abutments are in competent diorite gneiss and can take the thrust of the arch dam proposed. The tunnel route is also in this gneiss, and the penstock alinement is on a steep colluvial slope from tunnel outlet to powerhouse. The powerhouse site on diorite gneiss must be chosen carefully because of the potential hazard of slides from volcanic flows capping the hill. Needed exploration is outlined. — VSN

Wang, Ru-yih. *See* Williams, John A. 08596

Wanous, Richard E. *See* Broding, Robert A. 01052

01366 **Warme, John E.** Paleoecological aspects of a modern coastal lagoon: California Univ. Pubs. Geol. Sci., v. 87, 131 p., illus., tables, 1971.

Physiographic development, sediments, flora, and fauna were studied in Mugu Lagoon in southern California to determine facets of ecological history preserved in its sedimentary record. The modern lagoon is the last of a series developed behind barrier beaches, forming sequentially offshore. Beach sand, lagoon mud, and salt-pan silts have largely filled each lagoon. The present lagoon is divided into several environments, each characterized by a diagnostic suite of sediments, flora, and fauna, migrating as sedimentation proceeds. Plant species of the salt marsh around the lagoon are zoned by tidal levels. Faunas are dominated by large populations of a few species; vertical zonation is related to tide levels. Skeleton remains mirror distribution of live population; little postmortem transportation can be detected. In some environments, primary sedimentary structures are destroyed by biological reworking. — *from* Author's abstract

Water Levels Section Staff. *See* Wyatt, A. Wayne. 08439

08538 **Waters, Aaron C.; Fisher, Richard V.** Maar volcanoes, *in* Columbia River Basalt Symposium, 2nd, Cheney, Wash., 1969, Proc.: Cheney, Eastern Washington State College Press, p. 157-170, illus., 1970.

Examination of maar-type volcanic cones and tuff rings from more than 40 localities in western North America indicates that water had access to volcano orifices during their activity. Characteristic features of maar ejecta are continuous thin beds, undulations, and antidunes characteristic of base surge stratification, abundant accretionary lapilli or mud-armored rock particles, bedding sags that show soft sediment deformation, and — in subaqueous parts of the maar ramparts — great piles of subtly graded thin lenses of hyaloclastic debris. — DBV

01388 **Watkins, N. D.; Cambray, F. W.** Palaeomagnetism of Cretaceous dikes from Jamaica: Royal Astron. Soc. Geophys. Jour., v. 22, no. 2, p. 163-179, illus., tables, 1971.

The magnetic properties of basalt, andesite, trachyandesite, and hornblende-andesite dikes in the Central Inlier of Jamaica are variable but generally dominated by low oxidation state titanomagnetites. This has caused difficulty in defining a stable direction of magnetization. Nevertheless, two distinct paleomagnetic groups are recognized: eleven dikes possess virtual geomagnetic poles (VGP) which when averaged are indistinguishable from the previously-defined North American Cretaceous pole position, and four other dikes recorded closely-grouped equatorial VGP; both groups contain polarity differences. The favored interpretation is that Jamaica has not rotated significantly about a vertical axis since Cretaceous, and for a limited period regional geomagnetic field behavior resulted in low latitude virtual geomagnetic

poles, similar to previously described geomagnetic activity detected in Tertiary lavas of Hawaii, Alaska, Oregon, and Iceland. — *from* Authors' summary

08609 **Watson, Geoffrey S.** The statistical treatment of orientation data, *in* Geostatistics — A colloquium (D. F. Merriam, editor), Lawrence, Kan., 1970, Proc.: New York, Plenum Press, p. 1-9, 1970.

A short sketch will be given of the types of orientation data that have been described statistically. Some specific problems will be mentioned. An effort will be made to elicit new situations requiring statistical treatment. The discussion of past work indicates what can be done when a problem is formulated. — Author's abstract

Wayland, Russell G. *See* Smith, Merritt B. 01086

01159 **Weeks, L. Austin; Lattimore, Robert K.** Continental terrace and deep plain offshore central California: Marine Geophys. Researches, v. 1, no. 2, p. 145-161, illus., 1971.

Seismic-reflection profile investigations of the California continental terrace and Deep Plain between 35° N. and 39° N. support the hypothesis that the continental shelf and slope consist of alternating blocks of Franciscan and granitic-metamorphic basement overlain by younger sediments. North of 37° N. the profiles confirm the distribution of turbidites. Near 39° N. the ridge which forms the axis of the Delgada deep-sea fan consists of a thin cover of acoustically-transparent sediment unconformably overlying a thick sequence of turbidites; the southern part of the ridge is composed of well-defined short reflectors of variable dip. The ridge is incised by a steep-walled, flat-floored valley across its eastern flank. The acoustic basement north of 30°40′ N. is at least 0.5 sec (two-way traveltime) shallower than south of Pioneer Ridge. The ridge may represent as much as 0.5 sec additional basement relief. — *from* Authors' abstract

Weiblen, Paul W. *See* Grant, James A. 01174

Weir, Gordon W. *See* Schlanger, Seymour O. 01017

01304 **Weisbord, Norman E.** A new coral from the Bucatunna Clay (middle Oligocene) of Alabama: Tulane Studies Geology and Paleontology, v. 8, no. 4, p. 216-219, illus., 1971.

A new ahermatypic coral, *Paracyaathus macneilli* is described, illustrated, and compared. The species occurs in the Bucatunna Clay Member of the Byram Formation, and is considered a guide fossil of that member. A condensed stratigraphic account of the Byram Formation is also presented. — Author's abstract

Weiss, R. F. *See* Craig, H. 01040

01360 **Weiss, Ray F.** Solubility of helium and neon in water and seawater: Jour. Chem. and Eng. Data, v. 16, no. 2, p. 235-241, illus., tables, 1971.

The solubilities of helium and neon in distilled water and seawater have been measured microgasometrically over the range 0-40° C. The data are fitted to thermodynamically derived equations in temperature and salinity, expressing the solubilities of these gases in units of the Bunsen solubility coefficient, as well as in ml/liter and ml/kg from moist air at 1 atm total pressure. The fitted values have an estimated accuracy of ± 0.5 percent for both gases. Present results indicate that much of the excess helium in the oceans, attributed to radiogenic sources, is, instead, due to kinetic processes involving the entrapment of air at the sea surface. — Author's abstract

Welborn, Lawrence E. *See* Bennett, Harold J. 01331

08465 **Wells, John D.; Elliott, James E.** Geochemical reconnaissance of the Cortez-Buckhorn area, southern Cortez Mountains, Nevada: U.S. Geol. Survey Bull. 1312-P, 18 p., illus., tables, 1970(?).

The Cortez-Buckhorn area, where past production and reserves of metals amount to about 50 million dollars, contains carbonate sedimentary rocks in the lower plate of the Roberts Mountains thrust fault and siliceous rocks in the upper plate. Major igneous masses are the Mill Canyon stock and flows of basaltic andesite; small rhyolite bodies occur also. Many high-angle faults are present. Geochemical maps show that arsenic, mercury, and antimony anomalies are closely associated with gold and silver anomalies; copper, zinc, molybdenum, and tellurium are important indicators of mineralized zones. The stronger anomalies occur in fracture zones in carbonate rocks near granitic igneous bodies and in the igneous bodies; some weak anomalies are in the siliceous rocks. The Roberts Mountains thrust fault in this region localized only a few geochemical anomalies. — JDW

01038 **Wendland, Wayne M.; Donley, David L.** Radiocarbon-calendar age relationship: Earth and Planetary Sci. Letters, v. 11, no. 2, p. 135-139, illus., table, 1971.

Radiocarbon dated tree-rings from eight laboratories were analyzed by multiple regression and 250 yr means to determine the relationship between radiocarbon dates reduced to a common base and tree-ring (calendar) dates for the last 7100 yr. Both methods of analysis affirm the large scale differences reported elsewhere; however, they do not substantiate the previously reported smaller scale fluctuations. Radiocarbon ages are younger than calendar ages from the present to ca. 500 yr ago and from 2100 to 7100 yr ago. From ca. 500 to 2100 yr ago, the two chronologies are nearly equal. The calendar-radiocarbon age relationships for individual laboratories are presented. Although small systematic differences are noted, their significance cannot be assessed at this time due to limited data. — Authors' abstract

08652 **Wengerd, Sherman A.** Petroleum prospects in southwesternmost New Mexico, *in* Guidebook of the Tyrone-Big Hatchet Mountains-Florida Mountains region — New Mexico Geol. Soc. Field Conf., 21st, 1970: Socorro, N. Mex., New Mexico Bur. Mines and Mineral Resources, p. 90-104, illus., tables, 1970.

In this area are very thick Paleozoic and Cretaceous sedimentary rocks, shows of oil and gas in test drills, and several favorable structures. Exploration is limited by igneous intrusions and structure, and some areas to be avoided are named. Most favorable stratigraphic areas are in southern Hidalgo County, underlain by early Wolfcamp reefs, Hueco equivalent; trend is probably southeast and northwest from Big Hatchet Peak, or possibly arcuate between there and the Animas Mts. Discovery of structural traps is hampered by mantling alluvium and Tertiary volcanic rocks. Buried Laramide structures may be located by geophysical methods, but there may be no co-spatial relationship among Basin-Range, Laramide, and older structures; hence joint patterns, exposed folds in igneous rocks, or highs in alluviated areas may not be good indicators. — GDC

08671 **Wengerd, Sherman A.** Robert A. Zeller, Jr. [1925-1970] — A memorial, *in* Guidebook of the Tyrone-Big Hatchet Mountains-Florida Mountains region — New Mexico Geol. Soc. Field Conf., 21st, 1970: Socorro, N. Mex., New Mexico Bur. Mines and Mineral Resources, p. v, portrait, 1970.

Wenk, H. R. *See* Raymond, K. N. 01179

West, G. F. *See* Halls, H. C. 01334

Westbroek, Peter. *See* Johnson, J. G. 01349

08535 **Wheeler, Harry E.; Mallory, V. Standish.** Oregon Cascades in relation to Cenozoic stratigraphy, *in* Columbia River Basalt Symposium, 2nd, Cheney, Wash., 1969, Proc.: Cheney, Eastern Washington State College Press, p. 97-124, illus., 1970.

The "Sardine-Rhododendron" of the Cascade interior and some "Pliocene and Pleistocene" rocks, mapped by Wells and Pack (1961) and by Peck and others (1964), are misconstrued portions of the pre-basalt Little Butte; the succession of major constituents of the Cascade Tertiary was thus inadvertently inverted in areas totaling thousands of square miles. From reassignment of these extensively disordered rocks to their true positions below the Columbia River Basalt, it follows that

the Oregon segment of the Cascades, like its northerly and southerly extensions, is an extremely late Cenozoic (Cascadian) tectonic positive, and that the basalt succession has been arched over the main range mass. — DBV

08536 **Wheeler, Harry E.; Mallory, V. Standish.** Reply [to discussion by D. L. Peck, J. A. Wolfe, and A. E. Griggs of "Oregon Cascades in relation to Cenozoic stratigraphy" (1970)], *in* Columbia River Basalt Symposium, 2nd, Cheney, Wash., 1969, Proc.: Cheney, Eastern Washington State College Press, p. 131-132, 1970.

A few points of disagreement between Wheeler and Mallory (ibid., p. 97-124) and Peck and others (ibid., p. 125-130) are brought into sharper focus. — DBV

08455 **Whetten, John T.; Hawkins, James W., Jr.** Diagenetic origin of graywacke matrix minerals: Sedimentology, v. 15, nos. 3-4, p. 347-361, illus., tables, 1970.

Phyllosilicates and zeolites grew in Columbia River sediments during hydrothermal experiments at relatively low temperatures and pressures. Although the new minerals may not be equilibrium assemblages, our results strongly support the idea that matrix minerals in graywackes may be the result of alteration of components thermodynamically unstable in the environment of diagenesis. Scanning-electron micrographs show that the new minerals have formed as a mesh-like coating on original grains. The textural relationship of the new minerals to the original minerals resembles graywacke texture. — Authors' summary

01278 **White, E. M.** Contemporary soil wedge formation in western South Dakota: Soil Sci. Soc. America Proc., v. 35, no. 2, p. 306-309, illus., tables, 1971.

Subsoil tongues and wedges in western South Dakota form today by downward movement of surficial soil or sediment along cracks between prisms. Mass movement or rearrangement of the matrix soil accompanies wedge enlargement. Enlargement apparently ceases when loose surficial material is stabilized by vegetation or soil development. — Soil brief

08698 **Whiteman, C. D., Jr.; Calandro, A. J.; Broussard, W. L.** Water resources of the Slagle-Simpson-Flatwoods area, Louisiana: Louisiana Geol. Survey and Dept. Public Works Water Resources Pamph., no. 24, 23 p., tables, 1970.

Large quantities of ground water of good quality are available at Slagle and Simpson, and adequate but smaller quantities at and near Flatwoods. Yield of several hundred gallons per minute should be obtainable from large-diameter wells in each community. Specific capacities of wells at Slagle and Simpson are likely to be between 5 and 30 gpm per ft drawdown, and at Flatwoods 3 to 5 gpm per ft drawdown. At Slagle and Simpson several wells could be installed at a single location without mutual interference by completing each well in a different sand. At Flatwoods only one sand capable of sustaining high well yields contains suitable water for public-supply use. Streams draining the area would not furnish a reliable water supply without storage facilities. — *from* Authors' abstract

Wichmann, P. A. *See* Youmans, A. H. 01105

Wiggins, Ralph A. *See* Helmberger, Donald. 01077

Wigley, Perry B. *See* Peterson, Warren L. 01018

Wilcox, Ray E. *See* Gates, Olcott. 01236

Wilding, L. P. *See* Miller, F. P. 01280

Wilding, L. P. *See* Miller, F. P. 01281

Williams, J. D. H. *See* Shukla, S. S. 01276

01277 **Williams, J. D. H.; Syers, J. K.; Harris, R. F.; Armstrong, D. E.** Fractionation of inorganic phosphate in calcareous lake sediments: Soil Sci. Soc. America Proc., v. 35, no. 2, p. 250-255, illus., tables, 1971.

Preliminary studies have indicated that resorption of phosphate is particularly severe during NH_4F and NaOH extraction of calcareous lake sediments. This paper reports on causes of this error and improvements in separation of Fe- plus Al-bound P from Ca-bound P in calcareous materials. A fractionation scheme based on successive extraction with NaOH, citrate-dithionite-bicarbonate, and HCl reagents improved estimation of Fe- plus Al-P and of Ca-P in such sediments. — VSN

08596 **Williams, John A.; Wada, Ronald N.; Wang, Ru-yih.** Model studies of tidal effects on ground water hydraulics: Hawaii Univ. Water Resources Research Center Tech. Rept. 39, 80 p., illus., tables, 1970.

A model study on the propagation of periodic fluctuations in the piezometric head through a saturated porous medium is described. A hydraulic model consisted of one or more layers of polyurethene foam placed in a lucite tank. The foam was tested in a confined and an unconfined condition using both a no-flow and a constant-head boundary condition at the internal boundary. Mathematical and electric analog models duplicated the above conditions. Results of the study indicate that the diffusion theory can describe the propagation of such disturbances if boundary conditions are satisfied and the correct diffusion coefficient is used. Calculation of this coefficient requires that an appropriate storage coefficient and an apparent porosity be used for the confined and unconfined models respectively. For the unconfined case the ratio of apparent porosity to true porosity is similar for polyurethene foam and a Sacramento River sand. — *from* Authors' abstract

01072 **Williams, Richard J.** Equilibrium temperatures, pressures, and oxygen fugacities of the equilibrated chondrites: Geochim. et Cosmochim. Acta, v. 35, no. 4, p. 407-411, illus., 1971.

Olivine-pyroxene pairs from the equilibrated chondrites (types 5 and 6) record the following physical conditions: $T = 880° \pm 150°C$ and $P = 5 \pm 5$ kb. The oxygen fugacity at 880°C is $10^{-17.5 \pm 1.5}$. These oxygen fugacities plot on the graphite surface at 1 atmosphere total pressure. — Author's abstract

Williams, Roy E. *See* Abegglen, Donn E. 08463

08497 **Williams, Roy E.** Applicability of mathematical models of ground-water flow systems to hydrogeochemical exploration: Idaho Bur. Mines and Geology Pamph., no. 144, 13 p., illus., 1970.

This paper summarizes the results of studies which have utilized methematical models as a means of analyzing patterns of ground-water flow. The flow systems depicted by these models provide insight into source areas for geochemical anomalies observed in ground water. The procedure proposed consists of identification of geochemically anomalous ground-water discharge zones by a basin-wide sampling program. The recharge areas from which the anomalous, discharging ground water emanates are determined by the construction of mathematical models of the ground-water flow system in the basin in which the discharge area occurs. The criteria on which mathematical models are based must be determined by hydrogeologic investigation. — *from* Author's abstract

08585 **Williams, Roy E.; Wallace, Alfred T.** Hydrogeological aspects of the selection of refuse disposal sites in Idaho: Idaho Bur. Mines and Geology Pamph. 145, 31 p., illus., tables, 1970.

Geologic environments in Idaho are evaluated in light of results of studies on refuse disposal and ground-water contamination that have been conducted elsewhere. The hydrogeologic environments commonly considered most safe for disposal in any area are those with materials of low permeability and that are well above the water table. A third type of environment, one which is hydrogeologically protective, also must be

considered in a few areas. Hydrogeologically protective implies that a site can be engineered to prevent migration of leachate toward critical areas or that renovation of leachate by the porous medium will occur before it reaches critical areas. Hydrogeologic environments discussed are categorized according to geomorphic province or subprovince. Major communities in Idaho are placed within the appropriate geomorphic category for selection of safe disposal sites. — *from* Authors' abstract

08437 **Willman, Leon D.** Gem and mineral localities of southeastern United States, V. 2: Jacksonville, Ala., privately printed, 271 p., illus., 1970.

This book contains all new and different information from Volume 1 of the same title (1963); it does not replace or duplicate it. Organized in two sections, the first part lists gem and mineral localities alphabetically under the name of the gem or mineral. In the second part, the same localities are cross indexed, geographically, by state, with the various counties in each state included. In the back of the book are a number of maps indicating where to find various gems and minerals; most are bound in, a few are "in envelope." — GDC

01317 **Wilshire, H. G.; Howard, Keith A.; Offield, T. W.** Impact breccias in carbonate rocks, Sierra Madera, Texas: Geol. Soc. America Bull., v. 82, no. 4, p. 1009-1017, illus., table, 1971.

Deformational breccias in the Sierra Madera cryptoexplosion structure are either monolithologic or mixed. The former generally do not show mineralogic signs of shock deformation, but a few samples are shatter-coned, suggesting simultaneous formation of breccia and cones. Mixed breccias contain material showing signs of shock pressures of 50 to more than 200 kb. This, plus the structural geometry of Sierra Madera and orientation of shatter cones, indicates an impact origin. Breccias in cryptoexplosion structures in various terranes resemble those of Sierra Madera and may also have formed by impact. — *from* Author's abstract

01116 **Wilson, Edward C.** Friends of the Pleistocene Chihuahua: Terra, v. 9, no. 3 (1970-71), p. 19-23, illus., 1971.

This is a popular discussion of concretions and geodes, the varieties to be found, and their genesis. Examples from the collection of the Natural History Museum of Los Angeles County are illustrated. — VSN

08692 **Wilson, James Lee.** Depositional facies across carbonate shelf margins, *in* Exploration concepts for the Seventies: Gulf Coast Assoc. Geol. Socs. Trans., v. 20, p. 229-233, illus., 1970.

Nine depositional facies are described in idealized sequence across a typical carbonate shelf margin. These facies are: basinal, tidal shelf, basin margin, platform foreslope, organic reef, platform edge sands, open marine platform, restricted marine platform and platform evaporite facies. Each of these is characterized by sedimentological parameters, prevailing rock types, color, microfacies, sedimentary structure, terrigenous content, and characteristic biota. Description of this very widespread sequence should aid in location of reservoir rock. — Author's abstract

01397 **Wilson, L. G.** Investigations of the subsurface disposal of waste effluents at inland sites: U.S. Off. Saline Water Res. and Devel. Prog. Rept. 650, 106 p., illus., tables, 1971.

Two common techniques for brackish waste disposal at inland sites are evaporation ponds and deep-wells. A third possible technique consists of *in situ* mixing of waste water and indigenous ground water, using single- and two-well recharge-discharge or pit recharge. The two-well method appears to be the most favorable technique. Reasonably good mixing also occurred during pause and pulse type, single-well tests. During pit-recharge studies, mixing of pit-recharged effluent and river water occurred in materials of the zone of aeration. To maximize dilution potential of seepage from ephemeral streams, pit recharge should be timed to coincide with periods (a)

when mounds in the zone of aeration are fully developed, and/or (b) when river flows are occurring. Operation of pumping wells near a recharge pit will augment mixing. — *from* Author's abstract

08566 **Wilson, L. R.** Palynology in the university curriculum, *in* Teaching paleontology — North Am. Paleont. Convention, Chicago, Ill., 1969, Proc., Pt. A: Lawrence, Kans., Allen Press, p. 46-53, illus., table, 1970.

Some of the many facets of palynology are illustrated. They cannot be imparted in any single course. Seminars and special projects must expand the offerings of formal courses. There are vast areas of palynology still unexplored and specific subjects investigated by students can be as inspirational as any academic experience. Some results of these projects can be published. — DBV

Wilson, Stephen E. *See* Pike, Richard J. 01326

Witherspoon, Paul A. *See* Neuman, Shlomo P. 01218

Wold, Richard J. *See* Ostenso, Ned A. 01158

01363 **Wolf, Frederick A.; Nease, Felton R.** Assimilatory pigments in leaves of Pleistocene age from eastern North Carolina: Elisha Mitchell Sci. Soc. Jour., v. 87, no. 1, p. 18-19, illus., 1971.

Yellow-green leaves of several herbaceous and woody species of plants were found in a black sediment of Wisconsinan age (about 20,000 years old) 15 feet below the surface in a phosphate mine near Aurora, N.C. Chlorophylls were identified among the pigments that were extracted in methanol, aggregated in petroleum ether, and analyzed by spectrophotometer. The yellow-green pigments turned brown by photooxidation after exposure to air and light for a short time. The most important factors in preservation of the pigments seem to be lack of oxygen, lack of light, and continuously cool temperatures. — *from* Authors' abstract

Wolfe, Jack A. *See* Peck, Dallas L. 08534

08436 **Wolhuter, L. E.** Geology of the northwest quarter of Lévy township, Abitibi-East electoral district — Preliminary report [also French edition]: Quebec Dept. Nat. Resources Prelim. Rept. P.R.-595, 26 p., table, geol. map, 1970.

In this drift covered Precambrian map-area (no. 1720), with glacially disarranged drainage, Keewatin-type volcanic greenstone is intruded by a layered ultramafic sill, and a late massive granitic Opemisca pluton with large xenoliths in its syenitic margin. Petrology, metamorphism, and structural relations are described in some detail; the fine-grained volcanic rocks form a steeply dipping conformable sequence. The strike changes gradually from due west on the western boundary to northwest near Springer Mtn., then rapidly to north and northeast near the pluton contact. Faults are rarely exposed, but two sets striking NW and NNE are confirmed by underground mapping and drilling on copper mine properties in southwest Levy township. Extended exploration just north of this border has discovered no economical deposits. Available sand and gravel is almost unlimited. — GDC

01075 **Wollenberg, Harold.** Comments on paper by C. H. Scholz and T. J. Fitch, "Strain and creep in central California" [1970]: Jour. Geophys. Research, v. 76, no. 14, p. 3429, 1971.

In their discussion of strain and creep in central California, Scholz and Fitch (ibid., v. 75, no. 23, p. 4447-4453, 1970) showed that measured fault movement cannot explain long-distance geodimeter observations, and proposed that creep may be occurring on minor faults. Surveys across the Pleasanton faults in the western Livermore Valley indicate that measurable horizontal movement is taking place on faults that are minor compared to the neighboring Calaveras fault. Although the magnitude of horizontal movement cannot be determined because of the short (one year) time base, there is evidence of right-lateral offset on the Pleasanton faults. Measurements

across the Calaveras fault in the area revealed a very small right-lateral component but a significant thrusting resultant, consistent with the interpretation of the Calaveras as a thrust fault. — DBV

Wones, David R. *See* Hewitt, David A. 01121

Wong, Kia K. *See* Loring, Arthur P. 01325

Woodward, Lee A. *See* Crittenden, Max D., Jr. 01161

Woodward, Lee A. *See* New Mexico Geol. Soc. 08646

08648 **Woodward, Lee A.** Precambrian rocks of southwestern New Mexico, *in* Guidebook of the Tyrone-Big Hatchet Mountains-Florida Mountains region — New Mexico Geol. Soc. Field Conf., 21st, 1970: Socorro, N. Mex., New Mexico Bur. Mines and Mineral Resources, p. 27-31, illus., 1970.

Much of the so-called Precambrian of southwestern New Mexico needs isotopic study, before ages and sequences of events can be firmly established. At least two episodes of regional metamorphism preceded emplacement of granitic and related rocks. Most of these Precambrian rocks are granite that intruded older metamorphics. Graywacke terrane of the Black Range may represent a separate Precambrian subprovince of different geologic development. Anorthosite xenoliths in granitic rocks of the Burro Mts. batholith suggests more extensive anorthosite somewhere beneath the unconformably overlying rocks. Associated ore is possible, including copper, ilmenite, and titaniferous magnetite. Extensive geochemical study might provide directional indicators of dispersal patterns of sediment derived from ore bodies cut by the unconformity. — *from* Author's conclusions

Woodward, Lee A. *See* Corbitt, L. L. 08650

08670 **Woodward, Lee A.**[?]. Memorial to Harrison A. Schmitt [1896-1966], *in* Guidebook of the Tyrone-Big Hatchet Mountains-Florida Mountains region — New Mexico Geol. Soc. Field Conf., 21st, 1970: Socorro, N. Mex., New Mexico Bur. Mines and Mineral Resources, p. vi, 1970.

Wright, F. W. *See* Nilsson, C. S. 01074

08696 **Wright, Ruth V.; Chadbourne, Robert L.** Gems and minerals of the Bible: New York, Harper and Row, 148 p., illus., 1970.

The King James Version of the Scriptures has 1704 references to gemstones and minerals under 124 Greek and Hebrew names; some are obscure, others include those of increasing importance. Modern versions have used more familiar names, and mention gems and minerals which were known to ancient peoples; the correctness of such modern names has been verified by scientists and archeologists. Here, in 62 chapters, are given early history and full descriptions of that many materials, with scriptural references; the uses to which they were put and have been since then; trade routes by which they traveled, often thousands of miles from place of origin; research that has been carried out concerning their nature; the distribution of modern varieties; new finds, and modern compounds. Illustrated is a replica of Aaron's breastplate. — GDC

01118 **Wright, Thomas L.** Investigations at active volcanoes, *in* Volcanology, Geochemistry and Petrology, U.S. National Report, 1967-1971, Fifteenth General Assembly, IUGG: EOS, v. 52, no. 5, p. IUGG 57-62, tables, 1971.

This is a summary and bibliography of studies by U.S.-based investigators of active or potentially active volcanoes, mainly in Hawaii, Alaska, the Cascade Range. Central America, the Philippines, and the Galapagos. — DBV

08677 **Wright-Broughton, C.; Chamney, T. P.; Hennessey, W. J.; Eccles, J. K.; Brady, W. B.** A geological guide along the highways between Drumheller-Calgary-Lake Louise

— Prepared for AAPG and SEPM 1970 Convention: Calgary, Alberta, Alberta Soc. Petroleum Geologists, 44 p., illus., geol. map, 1970.

Geological guides along the following routes are given: Calgary to Banff along the Trans-Canada Highway; Calgary to Canmore along 1A; Banff to Lake Louise along the Trans-Canada Highway; Calgary to Drumheller; Drumheller to Willow Creek, and Drumheller to Morrin Camp Grounds. Geologic map 5-1967 of the Drumheller area, by E. J. W. Irish; another along the Bow River from Calgary to Lake Louise by R. A. Price and E. W. Mountjoy; and a stratigraphic section by J. K. Eccles, accompany the report. — ESL

Wu, C. H. *See* Papike, J. J. 01041

08439 **Wyatt, A. Wayne; Water Levels Section Staff.** Water-level data from observation wells in the Southern High Plains of Texas, 1965-70: Texas Water Devel. Board Rept. 121, 361 p., illus., tables, 1970.

Water-level records are presented from about 1500 wells in 32 counties in the Southern High Plains of Texas for the period 1965-70. This updates the previous report, No. 22, of 1966; an observation well network has been established in Borden, Garza, and Howard Counties since 1966, and data from these wells are included here. Most of the wells measured penetrate only the Ogallala Formation, the major aquifer in this area; the saturated thickness of this formation varies from less than 20 feet to more than 300. Most of the wells are in areas of large withdrawals of ground water for irrigation, industrial, and municipal use. Data are tabulated by county, well locations are shown on county maps, and level fluctuation curves (hydrographs) are given for selected wells. The principal long-term changes in levels reflect decreases in overall volume of stored water. — VSN

01119 **Wyllie, Peter J.** Petrologic aspects of plate tectonics, *in* Volcanology, Geochemistry and Petrology, U.S. National Report, 1967-1971, Fifteenth General Assembly, IUGG: EOS, v. 52, no. 5, p. IUGG 62-66, 1971.

So many papers published in the past four years refer to plate tectonics that this report relies heavily on recent review papers that provide entrance into the earlier literature of that period. Petrologic aspects of plate tectonics can be considered with respect to oceanic ridges and associated transform fracture zones, island arcs and continental margins associated with oceanic trenches, and the rigid plates. Plate tectonics provides a framework for the interpretation of petrology in various environments, while petrology provides information that can be used to support the models. It is obviously necessary to guard against circular arguments. — DBV

01133 **Wyllie, Peter J.** Melting relations, *in* Tectonophysics, U.S. National Report, 1967-1971, Fifteenth General Assembly, IUGG: EOS, v. 52, no. 5, p. IUGG 153-156, 1971.

This report outlines experimental results for the melting of elements, minerals, and rocks under various conditions, in a dry state or in the presence of water and other volatiles. To reduce to a minimum overlap with reports on experimental petrology, this review and bibliography is limited to melting curves and properties. — DBV

08586 **Wyoming Geological Survey.** Mines and mineral map of Wyoming: Laramie, Wyo., Wyoming Geol. Survey, scale 1:500,000, 1970.

01222 **Yang, Chih Ted; Stall, John B.** Note on the map scale effect in the study of stream morphology: Water Resources Research, v. 7, no. 3, p. 709-712, illus., table, 1971.

The Strahler stream order assigned to a particular stream segment depends on the scale of the topographic map used in ordering the network. However, the Horton-Strahler bifurcation ratio of stream number, stream length ratio, and stream concavity are found to be independent of map scale. Coefficients in Horton's laws obtained from a map system of one scale can be transferred to a map system of another scale if the stream order difference between the two map systems is given. Yang's theoretical

and equilibrium longitudinal stream bed profiles are shown to be independent of map scale and can be compared favorably with an actual profile obtained from a topographic map of any scale. — Authors' abstract

Yerkes, R. F. *See* Castle, R. O. 01113

01298 **Yong, R. N.; Osler, J. C.** Heave and heaving pressures in frozen soils [with French abs.]: Canadian Geotech. Jour., v. 8, no. 2, p. 272-282, illus., table, 1971.

The primary mechanism explaining heave and pressure is consistent with formation of ice lenses. There is general agreement on mechanisms forming the basis for the capillary model for prediction of frost heaving and associated pressures. Criteria used for assessment of frost susceptibility rely on admissibility of this model. This study questions the advisability of using a singular capillary model. Since soil freezing involves moisture movement and associated volumetric expansion arising from temperature and osmotic gradients, a comprehensive theory to explain heave and heaving pressures is needed to account for all major factors. Critical examination of recent tests shows that available theories may be too restricted to explain observed behavior of frozen natural soils. An extended generative mechanism is developed, and procedures for examination of actual results are presented. — *from* Authors' abstract

01105 **Youmans, A. H.; Bishop, W. Don; Wichmann, P. A.** Applications of the neutron lifetime log in new wells: Log Analyst, v. 12, no. 2, p. 3-12, illus., 1971.

The primary use of Neutron Lifetime Logs is for evaluation and recompletion of old wells, but recently the value of running this log when a well is first completed or before casing is set has been demonstrated. Base logs run early in the well history can indicate progressive changes in fluid saturation, or these base logs can be compared with those run at varying intervals subsequent to casing, cementing, and production, to identify permeable zones and to measure progressive changes in saturation whenever the different fluids have differing thermal neutron capture characteristics. By deliberate selection of drilling fluid filtrate to match the capture cross section of reservoir brine, residual oil saturation can be measured so as to identify immovable hydrocarbon deposits or establish water flood sweep efficiency. — VSN

01240 **Young, Merton A.** Eocene plants of the Midwest: Earth Sci., v. 24, no. 3, p. 124-129, illus., 1971.

Principal forms of Paleozoic fossils are invertebrates and plants; Precambrian, Mesozoic, and Cenozoic are rarely exposed in the Midwest. By Eocene time the Paleozoic ferns, club mosses, and calamites had been replaced by woody, deciduous trees and shrubs, and other angiosperms. These trees and their leaves and seeds fell into the backwaters of the Mississippi Valley and Eocene delta, and were buried and preserved in soft clay. The lagoons and ox-bow lakes now form one of the world's greatest deposits of kaolin and other clays. Preserved Eocene leaves indicate a warmer climate then than now. There is no invertebrate fauna to correlate these deposits. Some species that were quite numerous then, failed to remain among dominant groups of the present. Some probably left no descendants, and others were ancestral forms of modern plants. — ESL

01219 **Youngs, E. G.** Seepage through unconfined aquifers with lower boundaries of any shape: Water Resources Research, v. 7, no. 3, p. 624-631, illus., 1971.

An analysis of seepage through unconfined aquifers with lower boundaries of any shape is presented. The differential equation describing the flow includes a term that involves pressure distribution on the lower boundary. An inspection of a given problem gives extreme values of any unknown terms with a final result of known precision. The application of the analysis, checked by electric analog experiments, is illustrated by two examples of seepage problems: the seepage over an inclined plane between two parallel ditches, and the seaward flow of freshwater fed by a freshwater reservoir or by rainfall and supported on saline water from the sea. — *from* Author's abstract

01313 **Zartman, Robert E.; Marvin, Richard F.** Radiometric age (Late Ordovician) of the Quincy, Cape Ann, and Peabody Granites from eastern Massachusetts: Geol. Soc. America Bull., v. 82, no. 4, p. 937-957, illus., tables, 1971.

Several intrusive granite bodies (Quincy, Cape Ann, and Peabody) have been dated using three different methods. The Pb-Pb zircon age is 450 ± 25 m.y. (Late Ordovician) for all, whereas the amphibole K-Ar and whole-rock Rb-Sr ages reflect post crystallization disturbances. Quincy Granite reflects late Paleozoic low-temperature alteration, and the Cape Ann and Peabody Granites reflect a Devonian heating. — AH

08647 **Zeller, Robert A., Jr.; Kinney, Edward E.** Stratigraphy of the Big Hatchet Mountains area, New Mexico — A condensation [of paper by Zeller, 1965], *in* Guidebook of the Tyrone-Big Hatchet Mountains-Florida Mountains region — New Mexico Geol. Soc. Field Conf., 21st, 1970: Socorro, N. Mex., New Mexico Bur. Mines and Mineral Resources, p. 44-57, illus., 1970.

This condensation of New Mexico Bur. Mines and Mineral Resources Mem. 16, 1965 [*see* Abs. North American Geology, March 1966], was prepared by Edward E. Kinney after the untimely death of the author. Most of the illustrations and many of the details of stratigraphic descriptions and a list of references have been omitted. Included is a stratigraphic nomenclature chart, compiled by Kinney, showing usage in Big Hatchet Mountains area, adjacent Mexico, and southeast New Mexico. — GDC

08669 **Zeller, Robert A., Jr.** Petroleum geology of southwestern New Mexico [abs.], *in* Guidebook of the Tyrone-Big Hatchet Mountains-Florida Mountains region — New Mexico Geol. Soc. Field Conf., 21st, 1970: Socorro, N. Mex., New Mexico Bur. Mines and Mineral Resources, p. 87, 1970.

Zen, E-An. *See* Fisher, James R. 01175

01141 **Zietz, Isidore.** Magnetic anomalies over the continents, *in* Geomagnetism and paleomagnetism, U.S. National Report, 1967-1971, Fifteenth General Assembly, IUGG: EOS, v. 52, no. 5, p. IUGG 204-209, 1971.

Most of the magnetic coverage over continents has been made via aircraft. Much work has been done by oil and mining companies, but most of the data have been made available to the public. Most of the published aeromagnetic data in the United States have been provided by the U.S. Geological Survey. Regional surveys are summarized. The most significant advance in instrumentation in the past four years has been development of the vertical gradiometer. Much attention has been given to developing and improving various convolution operations useful in separating magnetic anomalies that appear on maps. Statistical and other approaches have been made to the analysis of aeromagnetic maps. Model techniques continue to play an important role in magnetic interpretation. Computer interpretations have met some resistance from those who have reservations about relinquishing too much control to the computer. — DBV

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